CHEMICAL & METALLURGICAL ENGINEERING

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S. D. KIRKPATRICK, Editor

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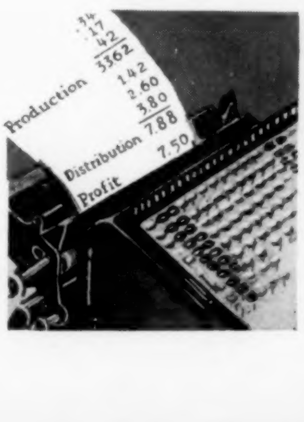
CHEMICAL COSTS

CHEMICAL industry is today in the process of readjusting itself to a long-continued — perhaps permanent — period of lower commodity prices. To continue to operate on a successful and profitable basis has called for a rigorous reduction in the costs of every department of the business. Never before has there been such a concerted effort toward economical operation. Engineers as well as executives have become "cost-minded." They apply but one yardstick to measure the worth of their efforts in production, research, development or distribution.

In this effort the engineer is sometimes handicapped by the unfortunate fact that chemical costs are seldom brought out in the open for frank study and criticism. They seem to represent the last stronghold of secrecy in an industry that once sought to spread a shroud of mystery over all of its activities. Many have remarked on the contrast with such fields as mining and metallurgy, where even twenty years ago the first thing shown to a friendly visitor at a Western mine or smelter was the company's cost sheet. Proud of such a record of his plant's achievements, the superintendent or operating engineer welcomed comment and the chance to profit from an exchange of ideas and experience. Of course, there are reasons why exactly comparable conditions can never obtain in highly competitive chemical industries. But there is no excuse for withholding cost information from the men who are responsible for making it. Even a foreman should have this measure of what his department is doing, provided the figures will help him to do a better job.

Chemical industry has no reason to be ashamed of its costs, of either production or distribution. Few industries compare in efficiency with that represented by the distribution of such commodities as sulphuric acid. Nor are profits in any sense excessive, considering the risk of a highly technical enterprise in an industry of constantly changing processes and products. Nevertheless, too many of our engineers and executives have been trained in the school of shortages — where production has been the major urge. Now, in a period of surpluses, production must be measured by sales. Profits must be made, even with reduced volume. More efficient distribution becomes our chief concern.

In chemical industry at least, there appear to be attractive opportunities for applying much of the same engineering knowledge and many of the methods that have been responsible for our increased production efficiency. This issue of *Chem. & Met.* is dedicated to those opportunities. It was conceived with the single aim of laying before the chemical engineer a picture of the relations between costs of production and distribution. It should help to broaden his view of the industry's major problem. It should encourage him to participate more effectively in the inevitable progress of the profession.

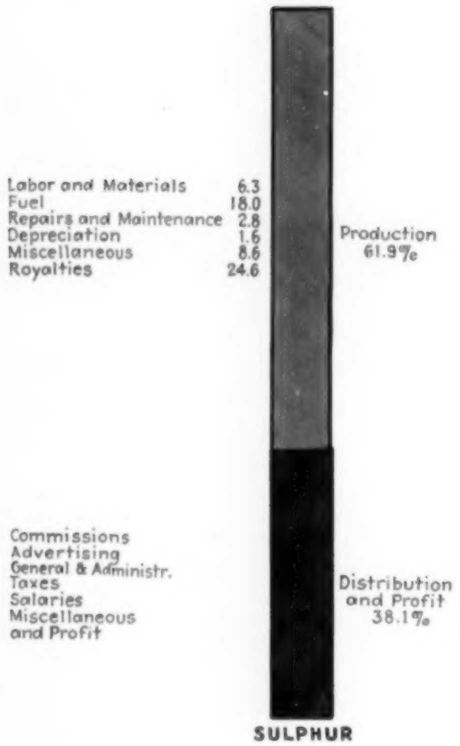


Production and Distributio

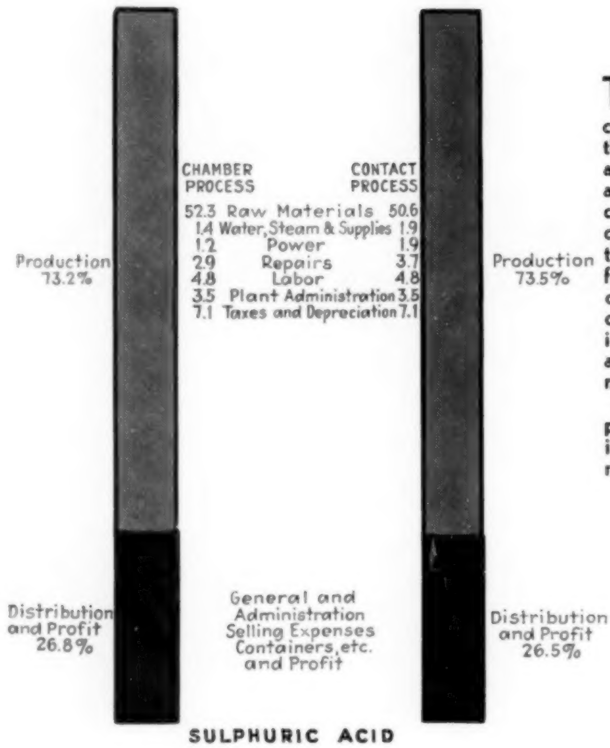
Yardsticks for the

THESE estimated costs of some of the most important chemicals of commerce have been collected by the editors of *Chem. & Met.* from a wide variety of sources, collated and interpreted in the form of percentages of the average selling prices of these commodities during the past three years. They are presented here for the primary purpose of giving the chemical engineer the broad picture of production-distribution relations in an industry in which there has been a paucity of published data on commodity costs.

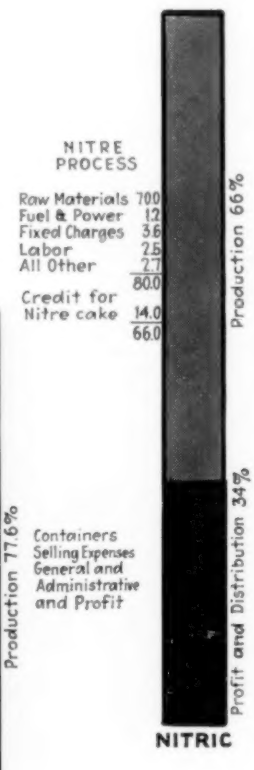
An attempt has been made to give percentages that are typical of capacity operations in the industries represented — not necessarily as low as



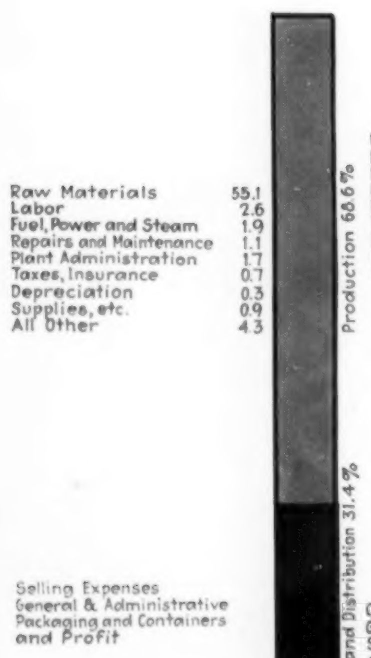
SULPHUR



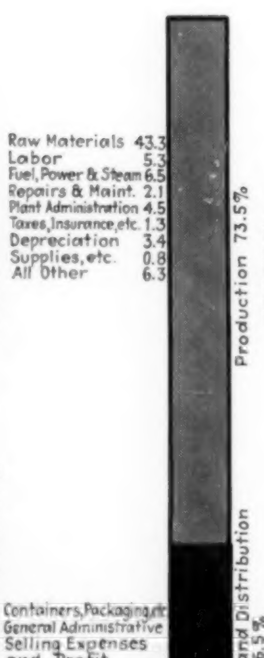
SULPHURIC ACID



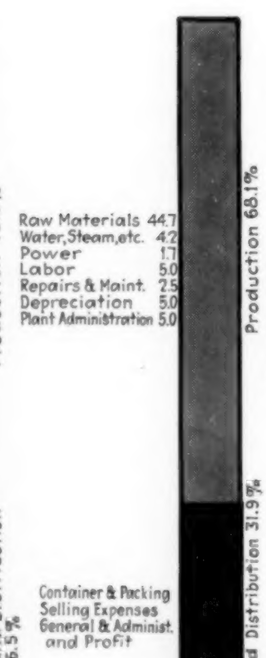
NITRIC



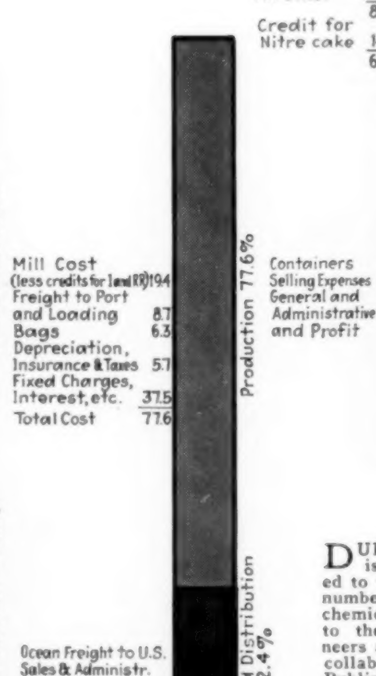
ACETIC ACID



ALUMINUM SULPHATE



TRI-SODIUM PHOSPHATE



CHILEAN NITRATE

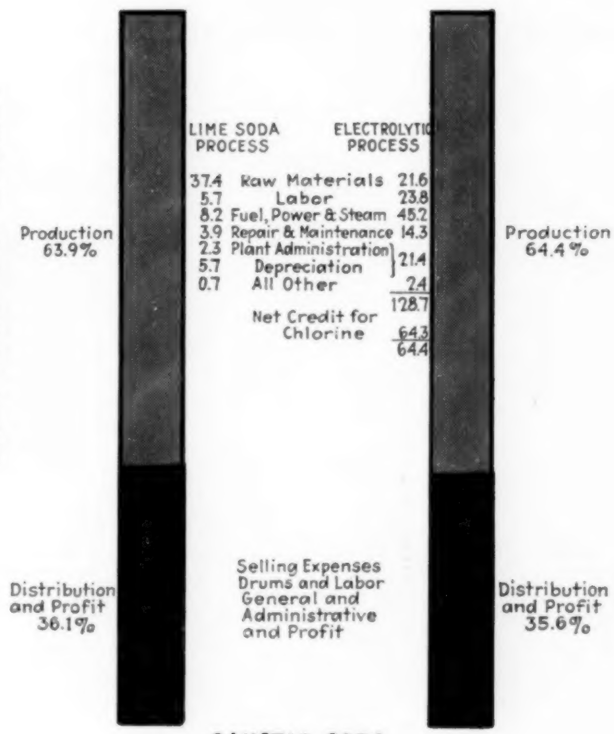
DUE acknowledgment is gratefully accorded to the executives of a number of important chemical companies and to the prominent engineers and economists who collaborated in this study. Published sources of information include the following: For sulphur, Haskins and Sells' "Report on Examination of Accounts of Freeport-Texas Co., for Three Years Ended Nov. 30, 1929"; for ultramarine blue and potassium per-

Costs of Typical Chemicals

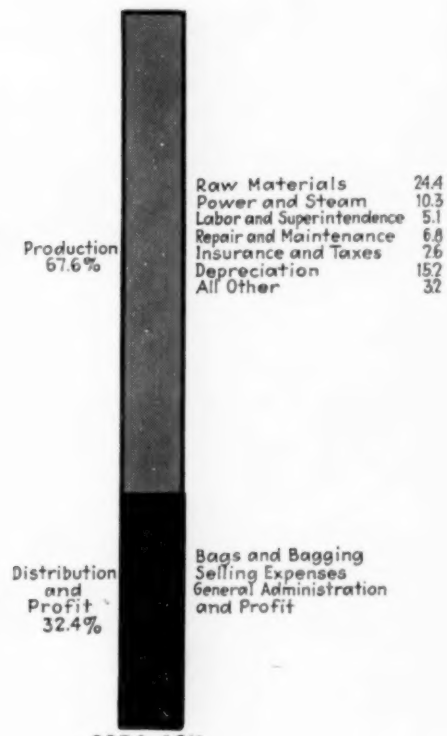
Chemical Engineer

the costs obtained in the largest or most modern plants, nor as high as those resulting from less efficient production. Furthermore, it must be evident that, due to differences in local conditions and to the lack of standardized accounting practices, wide variations may occur in the various elements that make up these costs.

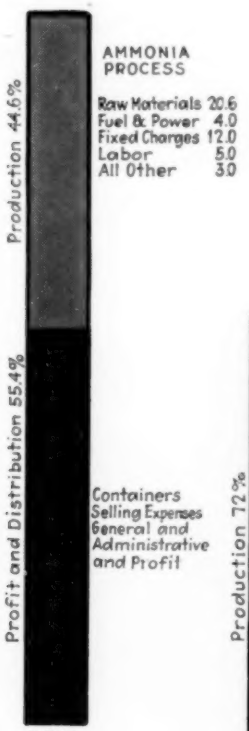
It is the expectation of the editors of *Chem. & Met.* that the publication of these estimates may stimulate the interest of the chemical engineer in the costs of the commodities he produces for industry. After all, these are the yardsticks with which management measures his achievements in both production and distribution.



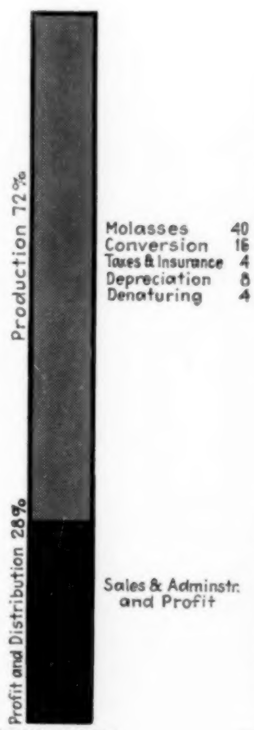
CAUSTIC SODA



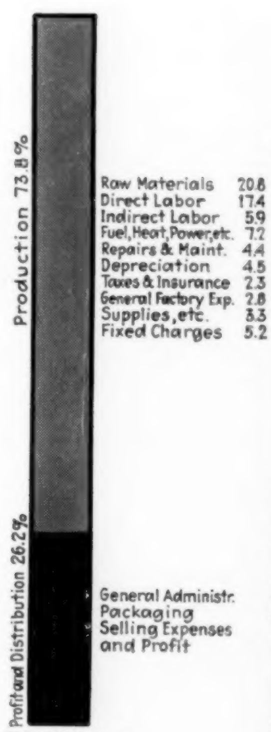
SODA ASH



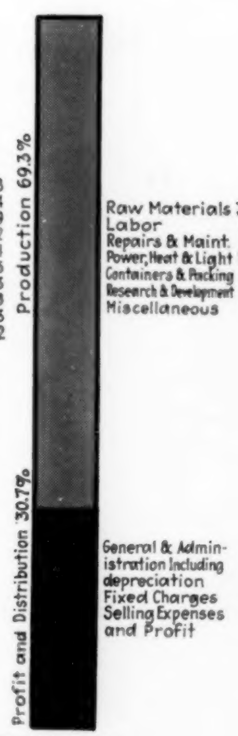
ACID



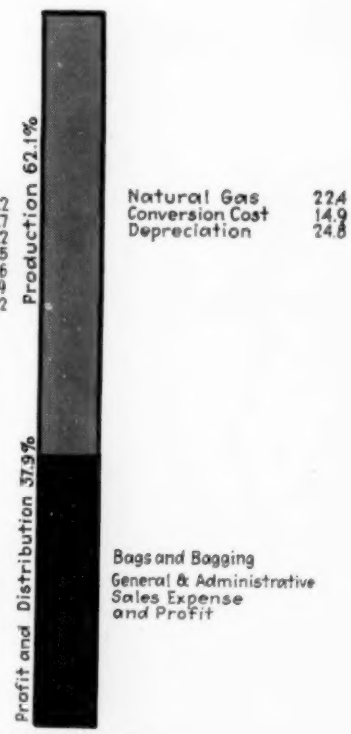
DENATURED ALCOHOL



ULTRAMARINE BLUE



POTASSIUM PERMANGANATE



CARBON BLACK

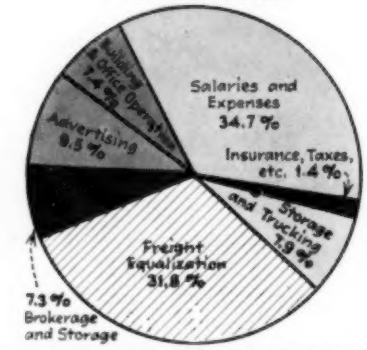
manganate, data from the reports of the U. S. Tariff Commission were supplemented by trade estimates for selling expenses and profits. Sulphuric acid costs are for 100 per cent acid from a 50-ton per day plant. Caustic soda figures are for 76 deg. solid; soda ash for 58 deg. light in bags; acetic acid made by acetate of lime process. All selling costs are average contract quotations f.o.b. producer's plant.

How Chemicals Compare

15 TYPICAL CHEMICALS *(See preceding page)*

A DRUGGIST'S PREPARATION

SELLING EXPENSES



FOR A LARGE CHEMICAL COMPANY

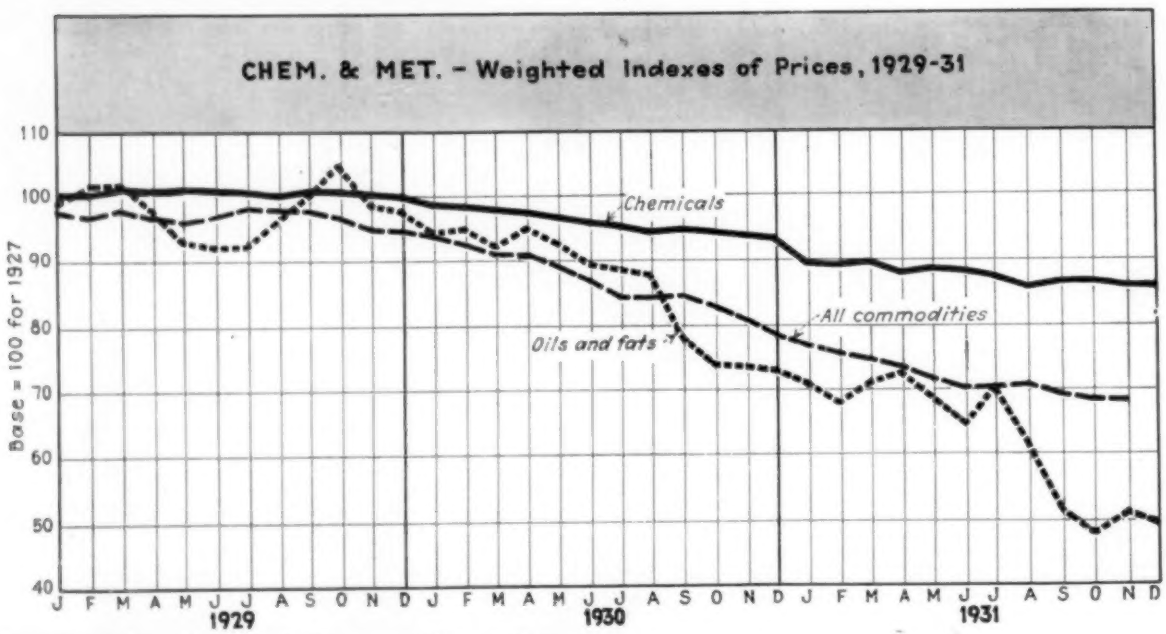
Salaries and Expenses	34.7 %
Building and Office Operation	7.4 %
Brokerage and Storage	7.3 %
Freight Equalization	31.8 %
Storage and Trucking	7.9 %
Advertising	9.5 %
Insurance, Taxes, etc.	1.4 %

Comparative Commodity Costs

(In percentage of sales dollars)

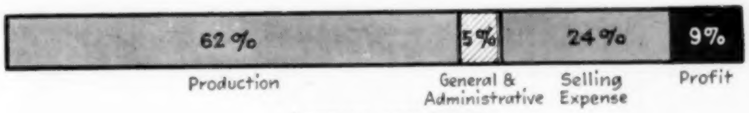
	Material	Labor	Distribution Overhead and Profit
CHEMICALS	35.6	10.3	54.1
Box shooks	49.8	26.7	23.5
Bronze parts	47.6	8.9	43.5
Candy	33.0	15.6	51.4
Carbonated drinks (incl. packages)	53.1	3.6	43.3
Caskets	38.4	22.1	39.5
Clocks	27.8	19.3	52.9
Clothing	51.0	17.0	32.0
Commercial (fixtures)	33.0	29.0	38.0
Corsets	49.0	11.0	40.0
Doors	38.2	19.1	42.7
Electric motors	34.0	14.0	52.0
Floor polish	30.0	1.3	68.7
Fountain pens	48.4	6.2	45.4
Furniture (upholstered)	56.6	16.8	26.6
Furniture (wood)	42.0	28.0	30.0
Heating apparatus	45.5	9.6	44.9
Hosiery (silk)	61.1	25.1	13.8
Kitchen cabinets	50.8	14.0	35.2
Mattresses	46.2	18.1	35.7
Mechanical rubber goods	46.1	8.5	45.4

Chemical costs are the average of 15 series shown on preceding pages. Comparative data are by Carlo M. Bigelow in *Factory and Industrial Management*, January, 1932.



Chemicals also compare favorably with all other commodities in their price and production trends. Here the Chem. & Met. price indexes for 30 chemicals and for 15 oils and fats are shown in their relation to the "All Commodities" index of the United States Bureau of Labor Statistics.

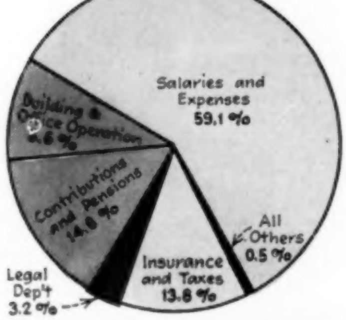
With Other Commodities



A FOOD PRODUCT

CHEMICAL ENGINEERING EQUIPMENT

GENERAL AND ADMINISTRATIVE EXPENSES



FOR A LARGE CHEMICAL COMPANY

Salaries and Expenses	59.1 %
Building and Office Operation	8.6 %
Contributions and Pensions	14.8 %
Legal Department	3.2 %
Insurance and Taxes	13.8 %
All Others	0.5 %

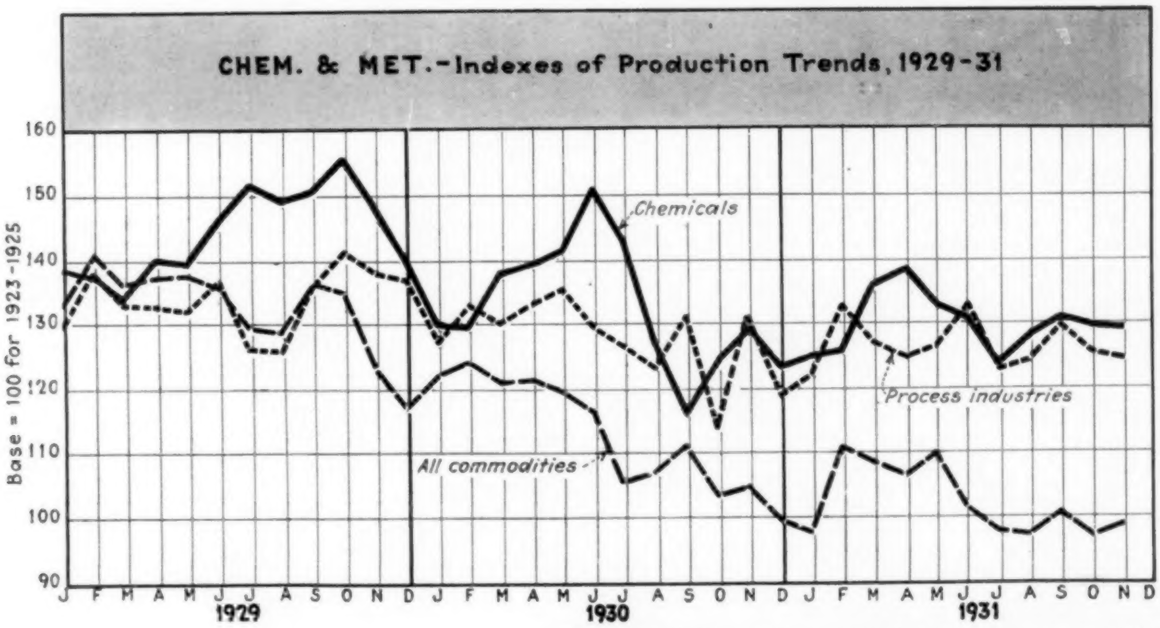
▼

Comparative Commodity Costs

(In percentage of sales dollars)

	Material	Labor	Distribution Overhead and Profit
CHEMICALS	35.6	10.3	54.1
Metal closures	42.6	6.4	51.0
Metal containers	45.0	13.7	41.3
Mill work	64.0	5.7	30.3
Oil burners	46.0	15.3	38.7
Overalls	51.2	20.1	28.7
Paper machinery	56.7	13.9	29.4
Pharmaceuticals	60.0	7.3	32.7
Pipe tools	22.4	14.4	63.2
Public seating	43.1	14.8	42.1
Refrigerators (commercial)	31.8	12.8	55.4
Roofing	53.3	5.4	41.3
Shipbuilding	44.0	31.0	25.0
Steel stampings	42.0	13.0	45.0
Structural steel (fabricating)	42.8	22.4	34.8
Tables	30.5	18.3	51.2
Tile	21.0	7.2	71.8
Underwear (knit)	38.1	25.8	36.1
Veneers	50.1	18.1	31.8
Washing machines	47.7	25.0	27.3
Wire rope	34.6	11.3	54.1

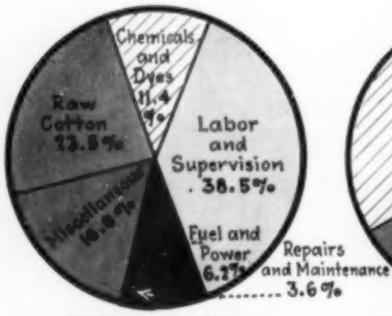
Chemical costs are the average of 15 series shown on preceding pages. Comparative data are by Carle M. Bigelow in *Factory and Industrial Management*, January, 1932.



Chemical industry and the process industries group as a whole have maintained their output at a considerably higher rate than industry in general, as measured by their electrical power consumption. The indexes shown here are compiled monthly in collaboration with Electrical World.

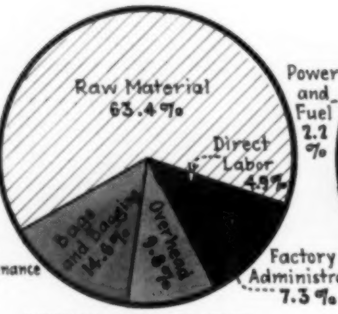
Chemicals and Other Materials

SOME TYPICAL



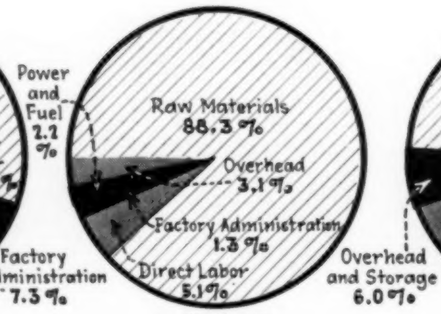
COTTON CLOTH

Labor and Supervision	38.5%
Raw Cotton	23.5%
Miscellaneous	16.8%
Chemicals and Dyes	11.4%
Fuel and Power	6.2%
Repairs and Maintenance	3.6%



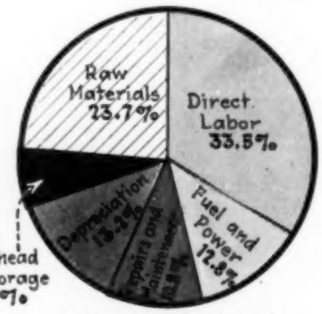
MIXED FERTILIZER

Raw Material	63.4%
Bags and Bagging	14.6%
Overhead	9.8%
Factory Administration	7.3%
Direct Labor	4.9%



SUGAR

Raw Materials	88.3%
Direct Labor	5.1%
Overhead	3.1%
Power and Fuel	2.2%
Factory Administration	1.3%



WINDOW GLASS

Direct Labor	33.5%
Raw Materials	23.7%
Depreciation	13.2%
Fuel and Power	12.8%
Repairs and Maintenance	10.8%
Overhead and Storage	6.0%

A TABULATION OF THE PRINCIPAL RAW MATERIAL

Chemicals

Sulphur	911,061 tons
Sodium nitrate	44,321 tons
Sulphuric acid, 50° Bé.	564,935 tons
Nitric acid, 100%	15,053 tons
Hydrochloric acid, 100 per cent	38,520 tons
Mixed acid	27,596 tons
Soda ash	382,311 tons
Caustic soda	105,703 tons
Pyrites	640,000 tons*
Crude barytes	58,000 tons*
Salt	5,000,000 tons*
Lime	530,000 tons*
Alcohol, ethyl	30,000,000 wine gal.*
Chlorine	90,000 tons*

Cement

Cement rock and limestone	43,292,000 tons†
Gypsum	1,210,000 tons†
Clay and shale	5,066,000 tons†
Blast-furnace slag	1,331,000 tons†
Marl	1,466,000 tons†
Oyster shells and other materials	1,558,000 tons†

Coke and Manufactured Gas

Coal	76,758,958 tons†
Sulphuric acid, 50° Bé.	935,000 tons*
Lime	30,000 tons*

Editor's Note: Unless otherwise stated these figures are from U. S. Census of Manufactures, 1929. *Denotes *Chem. & Met.* estimate; †Bureau of Mines data; ‡Bureau of Prohibition report. (Ton 2,000 lb.)

Ceramics

White lead	4,246 tons†
Litharge	8,663 tons†
Red lead	903 tons†
Salt	50,000 tons*
Slip clay	1,822 tons†

Explosives

Sulphuric acid, 50° Bé.	133,656 tons
Nitric acid, 100%	105,781 tons
Ammonia	12,000 tons*
Sulphur	40,000 tons*
Alcohol, ethyl	6,000,000 wine gal.*
Toluol	500 tons*
Glycerin	30,000 tons*
Sodium nitrate	109,385 tons†
Charcoal	9,003 tons†
Wood pulp	12,886 tons†

Fertilizers

Cottonseed meal	84,762 tons
Tankage	208,809 tons
Dried blood	12,651 tons
Ammonium sulphate-nitrate	36,317 tons
Calcium nitrate	10,647 tons
Fish scrap, meal and tankage	149,887 tons
Ammonium sulphate	460,505 tons
Calcium cyanamide	77,389 tons
Sodium nitrate	240,403 tons
Bones, ground, steamed	45,676 tons
Whale guano	11,841 tons
Guano, other than whale	28,966 tons
Kainite	81,119 tons

Fertilizers (Continued)

Muriate of potash	228,319 tons
Sulphate of potash	77,043 tons
Manure salts	389,884 tons
Other potash bearing salts	90,497 tons
Other fertilizer materials	869,848 tons
Phosphate rock	2,291,037 tons
Sulphur	339,088 tons
Pyrites	201,384 tons
Superphosphates, purchased.	
Basis 20% or less	1,320,694 tons
Basis over 40%	47,337 tons
Superphosphates, made and consumed. Basis 20 per cent	1,601,685 tons
Sulphuric acid, 50° Bé. made and consumed	1,373,033 tons
purchased	922,150 tons

Glass

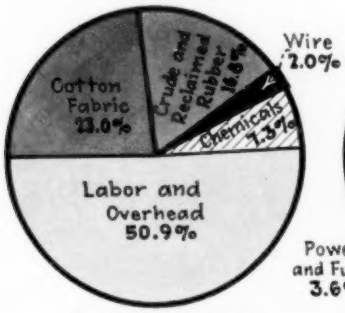
Silica sand	1,950,000 tons*
Soda ash	672,000 tons*
Salt cake	47,000 tons*
Lime	75,283 tons†
Limestone	366,000 tons*
Grinding sand	1,280,000 tons*

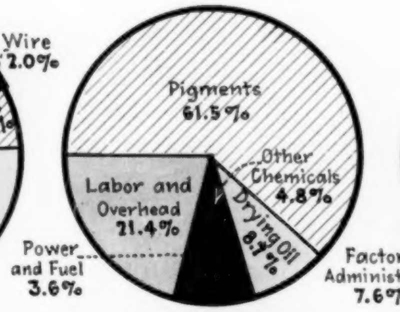
Leather

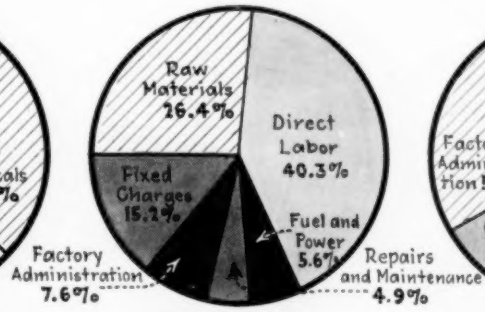
Lime	67,046 tons†
Salt	100,000 tons*
Sodium bichromate	11,000 tons*
Alum	500 tons*
Sulphuric acid, 50° Bé.	5,000 tons*
Soda ash	2,000 tons*
Hydrochloric acid, 100 per cent	1,500 tons*
Alcohol, ethyl	844,799 wine gal.‡

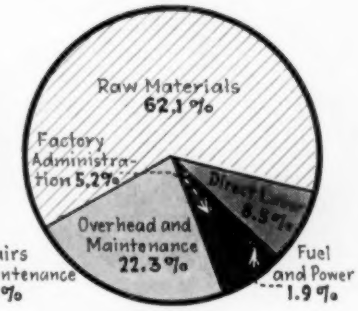
s Consumed in Process Industries

FACTORY COSTS









RUBBER TIRES

Labor and Overhead	50.9%
Cotton Fabric	23.0%
Crude and Reclaimed Rubber	16.8%
Chemicals	7.3%
Wire	2.0%

OUTSIDE PAINT

Pigments	61.5%
Labor and Overhead	21.4%
Drying Oil	8.7%
Other Chemicals	4.8%
Power and Fuel	3.6%

RAYON YARN

Direct Labor	40.3%
Raw Materials	26.4%
Fixed Charges	15.2%
Factory Administration	7.6%
Repairs and Maintenance	4.9%

SOAP

Raw Materials	62.1%
Overhead and Maintenance	22.3%
Direct Labor	8.5%
Factory Administration	5.2%
Fuel and Power	1.9%

REQUIREMENTS OF THE PROCESS INDUSTRIES

Oils and Greases, Animal and Vegetable

Cottonseed	5,009,034 tons
Flaxseed	1,149,944 tons
Copra	277,714 tons
Coconuts and skins	1,812 tons
Castor beans	83,808 tons
Soya beans	40,537 tons
Peanuts	26,280 tons
Corn germs	223,980 tons
Olives	3,491 tons
Mustard seed	928 tons
Caustic soda	11,000 tons*
Lime	6,000 tons*
Sulphuric acid, 50° Bé.	10,000 tons*
Fullers earth	10,685 tons†

Paper and Pulp

Sulphur	250,000 tons*
Salt	50,000 tons*
Alum	100,000 tons*
Chlorine	70,000 tons*
Soda ash	110,000 tons*
Caustic soda	45,000 tons*
Silicate of soda	15,000 tons*
Salt cake	185,000 tons*
Lime	411,017 tons†
Limestone	360,000 tons*
Rosin	38,390 tons
Rosin sizing	99,443 tons
Casein	18,451 tons
Clay	470,528 tons
Wood pulp	6,289,318 tons
Rags	739,422 tons
Paper stock	3,841,942 tons
Manila stock	128,800 tons
Straw	575,263 tons
Pulpwood	7,645,011 cords

Paints and Varnishes

Pig lead	200,013 tons
Crude barytes	243,000 tons*
Sulphuric acid, 50° Bé.	225,000 tons*
Nitric acid, 100 %	7,500 tons*
Acetic acid, 28 %	10,000 tons*
Alcohol, ethyl	17,121,142 wine gal.‡
Sodium bichromate	3,500 tons*
Zinc oxide	55,600 tons
White lead	136,526 tons†
Basic lead sulphate	13,435 tons†
Litharge	11,236 tons†
Red lead	11,855 tons†
Orange mineral	487 tons†
Lithopone	140,716 tons
Turpentine	4,300,000 gal.*
Linseed oil	190,878 tons
Other oil	47,208 tons
Iron oxides	34,750 tons
Lampblack and carbon black	4,792 tons
Shellac and resins	48,145 tons
Rosin	61,000 tons*
Clay	13,263 tons†

Petroleum Refining

Crude petroleum	1,039,921,589 bbl.
Natural gasoline	42,381,002 bbl.
Soda ash	18,441 tons
Sulphuric acid, 50° Bé.	1,483,863 tons
Caustic soda	134,054 tons
Fullers earth	301,607 tons†
Sulphur	1,500 tons*
Alcohol, ethyl	2,029,601 wine gal.‡

Sugar

Beets	6,950,526 tons
Cane	2,726,310 tons
Raw sugar	5,295,815 tons
Lime	20,758 tons†

Rayon

Wood pulp	48,294 tons
Cotton linters	30,568 tons
Caustic soda	111,000 tons*
Carbon bisulphide	21,000 tons*
Ether	1,600 tons*
Nitric acid, 100 %	12,000 tons*
Alcohol, ethyl	3,524,682 wine gal.‡
Copper sulphate	2,300 tons*
Ammonia	1,500 tons*
Sulphuric acid, 50° Bé.	150,000 tons*
Acetic anhydride	10,000 tons*
Acetone	815 tons*

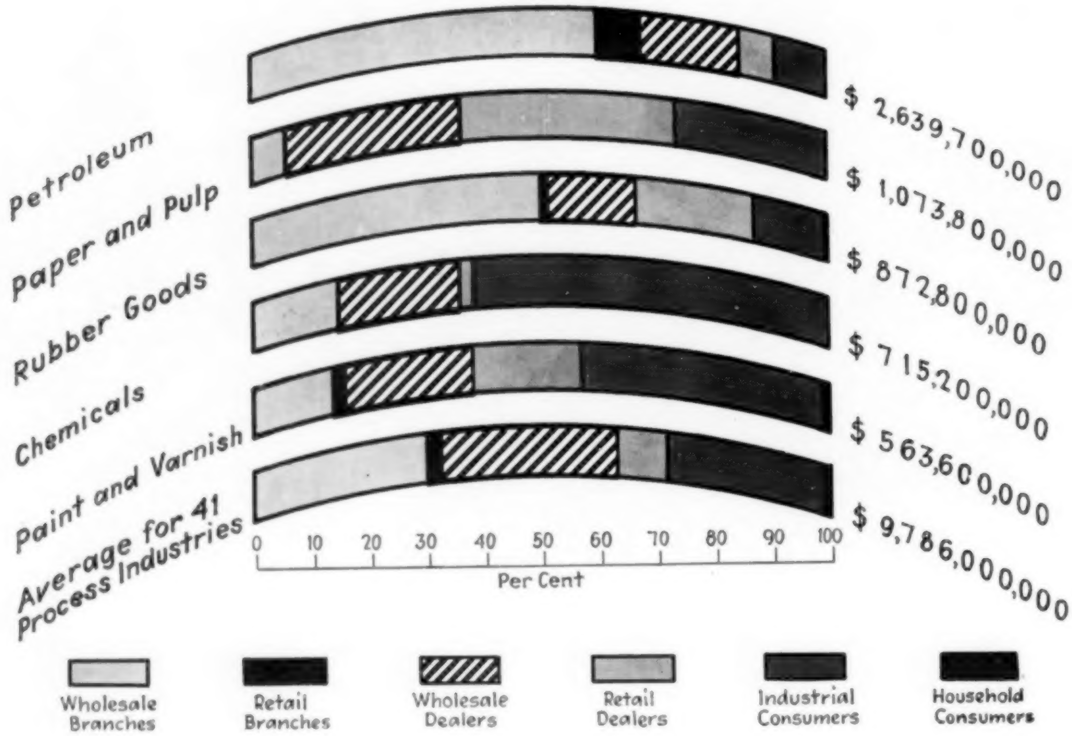
Rubber Goods

Crude rubber	517,553 tons
Reclaimed rubber	230,822 tons
Carbon black	84,444 tons
Zinc oxide	66,838 tons
Sulphur	30,648 tons
Tire fabrics	140,029 tons
Hose and belting duck	17,168 tons
Other cotton fabrics	35,077 tons
Lithopone	7,176 tons†
Litharge	6,651 tons†
Basic lead sulphate	655 tons†
Caustic soda	40,000 tons*
Kaolin	34,296 tons†

Soap

Animal fats	377,456 tons
Vegetable oils	104,712,586 gal.
Alkalis	286,509 tons
Abrasive materials	77,802 tons
Salt	100,000 tons*
Ammonia	500 tons*
Rosin	46,000 tons*
Hydrochloric acid, 100 per cent	1,300 tons*
Lime	40,000 tons*

SALES CHANNELS for $10,000,000,000 of GOODS SOLD ANNUALLY by PROCESS INDUSTRIES



What the New U. S. Census of Distribution Shows for the Principal Process Industries

Sales by Manufacturers of:	Total Value of Sales (Millions)	Sales to Owned Branches — Wholesale %	Wholesale $	Retail %	Retail $	Sales to Dealers — Wholesale %	Wholesale $	Retail %	Retail $	Sales to Consumers — Industrial %	Industrial $	Household %	Household $
Chemicals	$715.2	15.4	110.1	....	....	21.2	151.9	1.7	11.9	61.7	441.3	....	....
Drugs and proprietary compounds, etc.	318.9	11.9	37.9	4.0	12.9	47.5	151.4	21.7	69.3	8.4	26.7	6.5	20.7
Druggists preparations	124.7	31.3	39.0	1.0	1.2	33.0	41.2	18.3	22.9	16.4	20.4	....	....
Explosives	71.0	28.4*†	20.2*†	....	....	....	....	....	....	71.6	50.8	....	....
Fireworks	6.8	....	....	....	....	81.3	5.5	3.8	0.3	10.5	0.7	4.4	0.3
Ammunition	43.8	....	....	....	....	81.8	35.8	2.4	1.1	15.8	6.9	....	....
Fertilizers	240.7	10.1	24.3	0.9	2.3	15.7	37.8	32.1	77.2	....	....	41.2	99.1
Leavening compounds	52.0	48.4*	25.1*	....	....	39.9	20.8	9.9	5.2	1.8	0.9	....	....
Leather	399.5	19.8*	79.2*	....	....	32.6	130.3	....	....	47.6	190.0	....	....
Leather belting	34.5	7.9*	2.7*	....	....	21.7*	7.5*	....	....	70.4	24.3	....	....
Leather, artificial	32.6	....	....	....	....	29.1*	9.5*	....	....	70.9	23.1	....	....
Tanning materials, etc	37.5	9.0	3.4	....	....	24.5	9.2	....	....	66.5	24.9	....	....
Linseed products	118.2	6.6	7.8	....	....	45.7	54.1	2.1	2.5	45.6	53.8	....	....
Matches	19.6	72.3	14.2	....	....	22.5	4.4	5.2	1.0	....	....	....	....
Paint and varnish	563.6	14.1	79.2	1.9	10.8	22.7	128.1	18.4	103.8	41.3	232.6	1.6	9.1
Petroleum products	2,639.7	60.3	1,592.6	7.6	200.1	18.3	484.1	5.2	136.9	8.6	226.0	....	....
Rayon	149.6	36.0†	53.8†	....	....	....	....	....	....	64.0	95.8	....	....
Rubber, tires and tubes	770.2	48.5	373.3	0.5	4.1	8.2	63.0	17.0	131.2	25.6	197.4	0.2	1.2
Rubber, boots and shoes	102.6	52.4	53.7	....	....	24.2	24.9	23.4	24.0	....	....	....	....
Soap	310.2	32.8	101.8	....	....	45.5	141.2	13.6	42.0	7.6	23.7	0.5	1.5
Other cleansers, etc.	51.0	10.4	5.3	....	....	58.3	29.8	11.6	5.9	18.5	9.4	1.2	0.6
Sugar, beet	98.7	....	....	....	....	93.9	92.6	....	....	6.1	6.1	....	....
Sugar, cane	17.4	....	....	....	....	44.1	7.7*	....	....	55.9	9.7	....	....
Sugar, refined	507.4	26.1	132.3	....	....	53.3	270.4	12.1	61.5	8.5	43.2	....	....
Cement	267.5	10.5*	28.0*	....	....	73.0	196.5	....	....	16.5	43.0	....	....
Pottery	116.4	14.8	17.2	....	....	42.5	49.5	23.8	27.7	18.5	21.6	0.4	0.4
Other clay products	302.1	6.5*	19.7*	....	....	42.7*	129.1*	....	....	50.8	153.3	....	....
Sand-lime brick	3.1	....	....	....	....	52.4	1.6	....	....	47.6	1.5	....	....
Wall and floor plaster board, etc.	70.6	7.7	5.4	....	....	79.5	56.2	....	....	12.8	9.0	....	....
Linoleum, etc	90.6	2.6	2.4	....	....	76.0	68.8	18.8	17.1	2.6	2.3	....	....
Roofing materials	103.5	11.1	11.5	....	....	54.1	56.0	19.4	20.0	15.4	16.0	....	....
Paper and paper board	862.6	3.7	31.7	....	....	45.9	396.1	2.1	17.8	48.3	417.0	....	....
Paper goods	182.4	6.2	11.3	....	....	46.3	84.5	16.7	30.4	30.5	55.6	0.3	0.6
Pulp goods	28.8	7.2	2.1	....	....	3.2	0.9	89.6	25.8	....	....	....	....
Essential oils	6.6	9.2	0.6	....	....	19.8	1.3	3.7	0.2	67.3	4.5	....	....
Wood distillation products	29.6	25.2	7.5	....	....	27.1	8.0	2.9	0.9	44.8*	13.2*	....	....
Gum turpentine and rosin	26.5	4.2	1.1	....	....	86.5	22.9	0.4	0.1	8.9	2.4	....	....
Bone, carbon and lamp blacks	20.1	....	....	....	....	49.8	10.0	....	....	50.2	10.1	....	....
Printing ink	42.8	19.4	8.3	....	....	11.4	4.9	....	....	69.2	29.6	....	....
Carbon paper and inked ribbons	16.4	7.0	1.2	27.6	5.0	30.4	4.5	14.7	2.4	20.3	3.3	....	....
Wood, preserved	191.0	20.9	39.8	....	....	6.1	11.6	1.9	3.7	71.1	135.9	....	....
Total	9,786.0‡	30.1	2,943.7	2.4	236.4	30.8	3,003.6	8.6	842.8	26.8	2,626.0	1.3	133.5

*Includes minor amounts to retail agencies of similar ownership. †Includes some sales to non-owned agencies. ‡Note: This is not the entire output of the process industries group, since about $2,500,000 in goods are not yet reported or included in minor industries not tabulated here.

An Engineer Looks at Distribution

By T. M. McNIECE

Manager, Sales Records and Research
Union Carbide & Carbon Corp.
New York City

GRADUATING in 1907 from the Case School of Applied Sciences with the degree of Electrical Engineer, the author shortly became connected with the National Carbon Co., where for several years he was engaged in research and, later, in operating charge of manufacturing departments. Upon the formation of the Union Carbide & Carbon Corp. he installed new accounting and cost methods and took charge of the operation of these methods for the group of plants. Later, first as head of the plant accounting control division of the company, and since 1927 as manager of the sales records and research division, he has contributed largely to accounting and costing standardization and to improvement in office, sales, and distribution methods. He is a frequent speaker before business associations and a contributor to business papers.

MUCH has been said in recent years about the problems of distribution. It is safe to assume that the subject will continue to demand a great deal of time and attention. Is this quickening of interest due merely to a late realization of the importance of the subject or is the problem becoming one of increasing magnitude? Consideration of this question leads to the conclusion that both reasons prevail.

For industry in general, the cost of distribution has been an important part of total cost for many years. Production costs and the technique of securing and using them have been widely developed for the last 25 or 30 years. There are probably at least two reasons why similar and contemporaneous progress has not been made in the field of distribution. One is that the typical objective of most sales effort has been confined largely to the attainment of greater sales volume, with the underlying thought that each increase in volume will produce its quota of profit. The second reason is that many of the desired facts pertaining to sales and distribution are much more difficult to get than those of production. This latter condition undoubtedly has retarded progress in the control of selling and distributing effort from the profit-making standpoint.

There can be no question but that activities included within the functions of sales and distribution are becoming not only in totals, but relatively, of greater and greater magnitude. The Bureau of the Census furnishes the data of Table I in percentages indicating the shift in occupations since 1880:

There has been a slight change in classification during this interval, but not enough to modify the conclusions to be drawn from the figures. Similar data from the census of 1930 will not be available for several months. The trend from 1880 to 1920 is very conclusive and the assumption seems warranted that this trend is continuing up to the present time.

The major changes, as shown in the table, involve a large reduction in the relative number of persons engaged in agriculture, lumbering and fishing, a moderate increase in those working in manufacturing pursuits, and a relative increase of over 100 per cent in the number contributing principally to sales and distribution. As the facilities for communication and transportation have been improved the average distance between producer and user has increased, and what might be termed remote, multiple competition has grown without restraint. These changes all contribute to the increasing importance of selling and distribution costs.

Table I—Occupational Breakdown of United States

Year	Per Cent 1880	1900	1920
Agriculture, lumbering and fishing	49.4	37.4	27.2
Manufacturing, mechanical pursuits, and mining	25.6	29.1	33.1
Trade, transportation, and clerical work	12.2	18.7	24.8
Professional service	3.5	4.2	5.0
Domestic and personal service	9.3	10.6	9.9
	100.0	100.0	100.0

Most industries in recent years have individually experienced this rising trend in distribution costs that is suggested by the census data. It may be said at this point that an increase in production cost, if caused by improvement in quality, may warrant an increase in cost to the user of a commodity. An increase in cost of distribution, except for such part as may result from better service, gives nothing of greater value to the user. The census data previously given suggest a measure of increase in cost of distributive effort in terms of personnel.

Efforts on the part of many companies to increase sales volume have resulted in calling on more customers; and often in calling on the same customers more frequently. This has required more salesmen. Much of this is primarily chargeable to the spirit of competition. Similarly, the rapid growth in advertising has meant sharper and sharper competition for the reader's eye.

Without doubt, the statement may safely be made that nearly all industries are making some part of their sales at a loss. In these times of keen competition and narrow margins, it becomes quite essential for ultimate success to differentiate between profitable and unprofitable sales effort. How can this distinction be made? Under present conditions, the answer can be derived only by the logical analysis of markets and of the cost of reaching those markets. It must be realized at the outset that the primary objective of such work is increase of profits. It was previously suggested that the usual sales objective has been increase in volume, with relatively little thought given to the corresponding effect on profits. This failure to sense monetary return as the real goal of industrial activity is not confined to sales ranks, but is equally true of the production man, who is all too prone to consider costs no concern of his.

It may be contended with assurance that the ultimate object of market analysis is increase of profits. This

may or may not mean increase of sales volume. If study determines the existence of untouched or undeveloped markets which can be economically reached, the answer may be increased volume. If, on the other hand, analysis indicates that too much money is being expended on certain markets, the answer may point to the abandonment of unprofitable sales effort, with a more than compensating reduction in operating costs. It does not follow that all business in such areas will be lost. This latter step should never be advised or adopted until the marketing costs are thoroughly studied and reduced to a minimum. This is only the application of the same principle that has been applied to production costs for many years.

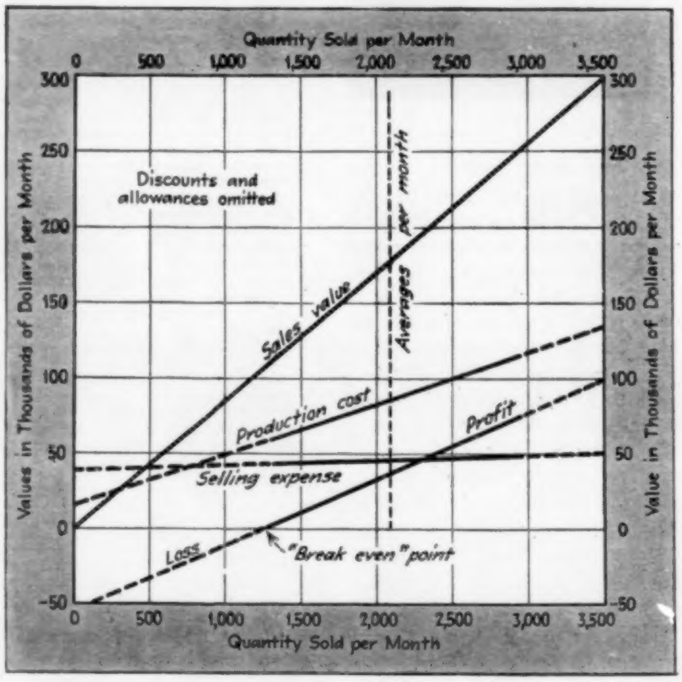
Intelligent action on this phase of the problem demands an understanding of the effect of volume on costs and profits. It is generally realized that the unit costs of production and distribution decline as volume increases. The exact nature of these changes is not generally understood. In the face of strong competition, price reduction, presumably justified by reduced costs through increased volume, is frequently recommended far beyond the point of profitable return. It seems desirable, therefore, to illustrate these relationships graphically in order to make the changing relationships clear. As a consequence, the charts on the following pages are introduced.

In Fig. 1 are illustrated the trends of sales value, production and sales costs, and resulting profits as the quantities produced and sold increase. These total values follow what may be termed "a straight-line law." The various curves were determined by plotting points representing the monthly values in a somewhat seasonal business, arranging them in sequence according to increasing volume. In producing such a chart it is essential that no important price changes occur during the period shown on any one graph.

All costs are divisible into two classes: variable and non-variable. If the straight line representing the average trend within the range of operations be projected to the left until it intersects the vertical axis, it will show at this intersection, for both production and sales expenditures, the approximate value of the non-variable costs at the prevailing level of output. The extension of the profit line until it intersects the horizontal axis will indicate the approximate quantity of monthly sales required in order to break even.

These relationships and values are both interesting and important in any consideration of policy, but their value is greatly increased by the use of the same factors expressed in ratio form. These are shown in Fig. 2. For convenience of reference, sales value is again shown on this chart, appearing as before in straight-line form. The remaining three graphs, expressing in turn the percentage relationship of production cost, selling expense, and profit to sales value, are curved lines, hyperbolic in form. Each is derived by dividing its monthly values, shown in Fig. 1, by the sales value for the same month. These three graphs depart from the straight-line form through the influence of the non-variable cost group.

Fig. 1—Effect of Sales Volume on Cost, Selling Expense, and Profits



The greater the proportion of non-variable costs to total costs, the sharper will be the curvature of the graph with changing volume. This may be indicated by reference to Fig. 1, wherein it will be seen that the proportion of non-variable charges is much greater in selling expense than in production costs, with a corresponding difference in curvature shown in Fig. 2. This relative condition between production and sales costs is generally likely to hold true, although it may not always prevail. This constitutes one of the differences in characteristics between production costs and selling expenses. If production levels are at a low ebb, many items of factory costs are quickly reduced. Under the same conditions, however, full sales and advertising effort may be expended in an effort to secure all available business. Expressed otherwise, selling expenses usually lack the elasticity of production costs, although both are very adversely affected by declining volume.

One of the important points to consider in evaluating the data of Fig. 2 is the fact that all of the curved graphs rather quickly approach a horizontal trend. Practically, this means that a limit is soon reached in most organizations where further increases in volume do not produce materially lower unit costs or higher unit profits. Unrestrained price reduction with volume increases may quickly lead to unprofitable operations on some sales.

At this point it may be suggested that proper unit prices may be considered as falling between two limits, each of which can be established only in general terms. If the sales price is so high that the unit margin of profit is unduly great, this condition may

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. . . Production men, deeply immersed in problems of design, schedules, quality, and personnel, are too strongly inclined to consider costs as byproducts to be handled only by those with no responsibility for production. This statement applies with special force to indirect costs or expense, in which will be found many intangible items comparable in a sense with the costs encountered in distribution. The point of view to be absorbed by production and sales group alike is that profit is the fundamental objective; that the product itself and the sales effort devoted to that product are merely the vehicles chosen for the attainment of profit. When this thought is thoroughly ingrained in the minds of those responsible for activities, all policies will be interpreted in terms of profit, which will automatically force a consideration of costs.

. . . Determination of demand is an outstanding problem in market analysis. Basically there are three questions that should be answered:

1. How much? The answer to this question largely governs the investment in plant and inventories.

2. Where? This answer influences the location of factories and warehouses, and has a great bearing on sales methods and policies, as well as location and size of the sales force.

3. When? A triple answer is required here. The first deals with the frequently very important seasonal factor and may involve manufacturing capacity. The second is concerned with the long-time trend. The third gages the stability of the demand in its relation to the world's economic surges.

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bring about two things: First, the large profit may induce competition to enter the business; and second, the long margin of profit will protect such competition while gaining strength for more effective effort. In this latter respect, the large unit profit offers the same advantages to new domestic competition as the protective tariff is expected to offer domestic companies against foreign competition.

On the other hand, the development of severe competition may force unit prices to such a low level that adequate profit is strictly dependent on the maintenance of large volume—a more difficult problem as competition becomes keener. Even though sales volume under these conditions is so large that total profits are satisfactory, the business will be in an extremely sensitive position, because profits resulting from large volume at low unit profit are especially susceptible to the influence of reduced volume. In other words, a small percentage decline in demand may wipe out all the profits. These conditions should be thoroughly considered in establishing price policies.

Chemical industry, perhaps more than any other major business, encounters great difficulties in production cost determination. This results from the fact that several products may often be produced simultaneously, so to speak, from the same materials, labor, and equipment. This makes it necessary to prorate costs upon some basis. Often the relationship between the commodities is that of major product and byproducts. What proportion of costs shall be assessed against each? Under such conditions the allocation of costs may be somewhat in proportion to expected sales prices. If an especially low price is made in order to move some relatively unimportant byproduct and, partially as a result of this low price, a new use of major proportions arises, the demand may exceed the supply as a byproduct. To produce the commodity as a major item may result in costs so high that the market will be destroyed or operations conducted at a loss. These are all variations of the problem induced by the volume-profit ratio.

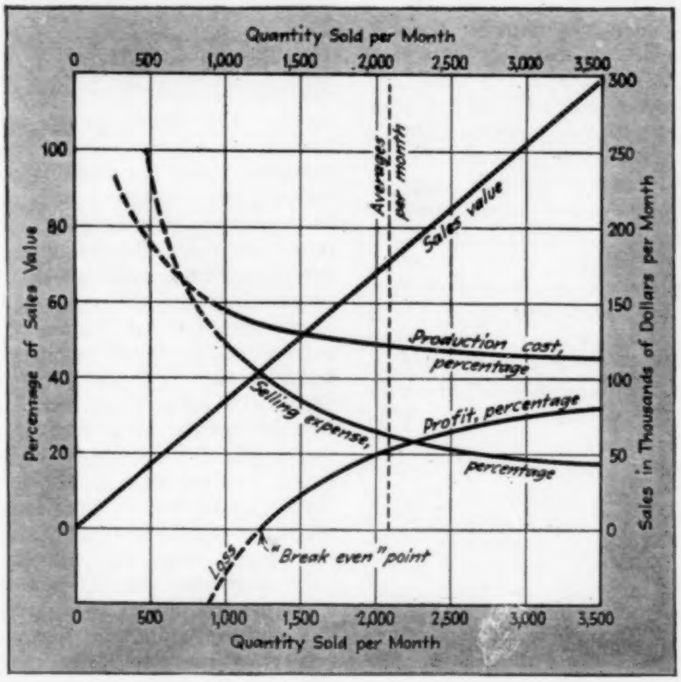

Fig. 2—Effect of Sales Volume on Cost, Selling Expense, and Profit Percentages

It will be noted in Figs. 1 and 2 that a vertical line marks the position of average monthly operations. In this case, capacity is quite well proportioned to available demand. Where excess capacity exists—and this means super-competition—the effect will be to increase the proportion of non-variable charges to total costs and also to move the line indicating average monthly costs farther to the left. This results in greater curvature of the ratio graphs and in placing the characteristic working position of the company on a steeper section of the curves. When such a condition is indicated, the business is much more sensitive to volumetric changes and the problem is more difficult. The solution is one of reduced non-variable charges, or increased volume, or both. Heavy chemical and other industries requiring extensive and high-priced equipment may encounter a relatively high proportion of non-variable charges. Profit expressed as a percentage of sales value alone is totally inadequate as a guide in formulating price policies. A price yielding a very high profit margin measured as a percentage of sales may give an entirely unsatisfactory margin expressed as a percentage of invested capital. The ratio between capital invested in productive equipment and the sales value of the product will vary widely among different products.

After all of this consideration of volume-profit trends, the conclusion seems increasingly clear that whether profitable volume should be increased or unprofitable business decreased, the matter is sufficiently complicated to warrant systematic study. As a matter of fact, the problems are so varied and so little understood that it seems fair to call this a field for research, just as definite as that occasioned by technical and laboratory problems.

Any plan of attack should be designed ultimately to differentiate between profitable and unprofitable

Products	Accounts
Territories	Orders

It should be obvious at once that any such distinction demands the determination of reasonably accurate costs in terms of each of the four divisions listed.

Products—With respect to cost distinction between products, it may be said that the cost of selling effort and distribution varies among products just as production costs and advertising costs vary among them. It is not unusual to find a ratio of three to one in selling and distribution costs on different products handled by the same organization. The influence of volume on cost has previously been discussed and this influence may vary among products.

Territories—With reference to territories, at least three factors should be known: namely, volume actually secured, total potential or available

volume, and the cost expended in securing that volume. This calls at once for market research. Is the cost expended commensurate with the volume secured and with the potential volume? Should more or less money be expended on the particular territory for any specific products? In the mad scramble for volume, fringe markets have been developed where it would be more profitable to let them alone. Where are the profitable markets? This is a problem of territorial determination. A great diffusion of market means heavy costs of selling and distribution if the whole area is to be covered. On the other hand, a sufficient degree of concentration may exist to make selective effort a profitable venture.

Data recently released by the U. S. Department of Commerce give a number of interesting measures of this concentration in industrial activity. There are in all 3,073 counties in the United States. Merely as a reference mark, the number and percentage of counties containing 75 per cent of certain types of activity are listed below in Table II.

Table II—Activity Distribution by Counties in United States

Counties Containing 75 Per Cent	Number	Percentage of Total Counties
Of total manufacturing establishments	393	12.8
Of wage earners in manufactures	209	6.8
Of wages paid in manufactures	145	4.7
Of cost of materials, fuel, power, containers	150	4.9
Of value of manufactured products	138	4.5
Of value added by manufacture	137	4.5
Of rated capacity of power equipment	341	11.1

This enormous concentration of industry at once suggests the desirability of locating the markets systematically and spending money for development of trade where it will yield the greatest profit.

Accounts — The distinction between profitable and unprofitable accounts requires a study of the relative value of customers. The same typical concentration of sales value among relatively few customers usually prevails in industry. Approximately 25 per cent of the accounts usually will be found to yield 75 or 80 per cent of the volume. This indicates the danger of expending so much sales effort on the remaining 75 per cent of the customers that their business may be unprofitable. Again, the value of selective effort seems apparent and yet there is latent danger in too much concentration. The danger lies in the ability of the large buyers to hammer prices down to the point where unit margins are small. As previously suggested, such business is in a state of sensitive balance with respect to profit, and the loss of one or two large customers may wipe out all profits in the business.

Orders—American business is saturated with small orders. The origin of these small orders is not limited to small companies. The importance of rapid turnover has in many ways been overemphasized, with a resultant trend to hand-to-mouth buying. Hand-to-mouth selling, originating in too frequent solicitation of the trade, has added its effect to that of excessive turnover rate in many instances, with the net result that a large proportion of office and clerical expense is properly chargeable to a small percentage of the sales. It takes essentially no longer to put a large order through the office routine than it does to handle a small order. A sizable proportion of office cost is dependent on the number of orders handled and not on the value included thereon. Under such conditions, the first requirement is a thorough study of office methods with a view to reduction in cost of handling. The next step may involve arrangements with customers that will result in larger average orders. Finally, it may be advisable to drop any business that is characteristically received in such small quantities that the busir ss is unprofitable. Naturally, such steps should be followed by more than compensating cost reductions. Many products regularly sell in smaller units of value than others. The smaller the characteristic sale, other conditions remaining the same, the larger should be the gross margin, in order to derive the same relative profit.

No fixed method of market analysis will apply to all products or to all industries. The variations within them are too great. For example, one business may sell to relatively few customers of high average demand; while another may have many customers greatly scattered and of widely varying requirements. An example of the former type would be the carbon electrode demand from the steel industry. The latter cases would be illustrated by the sale of motors, paints, or oils to general industry. This class involves a much more complicated problem of market determination.

Demand Determination Needed

Determination of demand is an outstanding problem in market analysis. Basically there are three questions that should be answered: how much, where, and when?

The answer to the first question largely governs investment in plant and inventories. The second answer influences the location of factories and warehouses and has a great bearing on sales methods and policies, as well as location and size of the sales force. The third question demands a threefold answer. It first involves the seasonable factor, which may be a most important item, especially in perishable or semi-perishable products. This may also influence the capacity of the manufacturing facilities. The second division of this question is concerned with the long-time trend. Is the commodity enjoying an increasing, a decreasing, or a stable unit demand? In the chemical industry, a complete reversal may occur almost over-night. It is most essential, therefore, that the demand for major products be determined by principal industries and that the future of these industries be carefully gaged. Obsolescence of product, process, or equipment may destroy a market without warning unless it is the delegated function of someone to keep in touch with such developments.

The third element of this answer involves the economic surges so important today. What are the characteristics of demand from customer industries? Does such demand have the relative stability of the food manufacturing industry or is it subject to the wide swings of the automobile trade? The utilization of plant facilities and capital investment will be much improved if these conditions are better known.

What Sort of Competition?

No market analysis is complete without a study of competition. Some commodities are made by many manufacturers. For others, production may be limited to relatively few competitors. Competition in the former case may be termed "high-frequency" competition; in the latter, "low-frequency" competition. They may be equally severe and yet the methods required to meet them successfully may differ radically. Aside from the so-called frequency of competition, what may its characteristics be? Is the chief competition one of price or of quality, or is it a combination of both? Is it local or national in scope? Is it stronger in some customer industries than in others? Again a coordinated knowledge of the facts is essential in planning the strategy to meet the situation.

Even these facts are not ordinarily enough. Frequently it will appear that the only way to meet some new competitive thrust on price, service, or other factor is the adoption of a like policy. But how successfully is the competitor operating under his chosen policies? The answer to this question may involve an analysis of his financial status. It may often be found, when this is done, that the troublesome competitor is surely headed for the rocks unless his policies are changed. Under such conditions it may be very unwise to follow his policies.

To many engaged in management, the accumulation of these facts may seem quite unnecessary. The ideas may even be termed too theoretical. Nevertheless the need for fundamental facts has never been greater. The need for interpretation of these facts is greater still. The country's condition today gives rather conclusive evidence that any business conducted by guess and by gamble is headed for trouble—trouble that might in a large measure be avoided if we only knew as much about our businesses as we should.

Cutting Costs of Chemical Sales

By WILLIAM M. RAND

Vice-president
Merrimac Chemical Co., Inc.
Boston, Mass.

THROUGH his many contributions to *Chem. & Met.* Mr. Rand is well known to its readers. After graduating from Harvard University in 1909, he began a business career that has given him a broad viewpoint on the problems of the chemical industry. After several years' experience in various capacities in banking he became treasurer of the City Fuel Co., of Boston. Mr. Rand left this position in 1917 to enter the services of the United States Navy, where he served as lieutenant, senior grade. His connection with the Merrimac Chemical Co. dates from the end of the World War, and he has served that company successively as treasurer, sales manager, and vice-president.

HOW OFTEN we hear, "the grass is always greener in the other fellow's yard." The manufacturer of luxuries may say to the industrial chemical manufacturer, "Well, anyway, they have to have your product to keep going." In turn, the chemical manufacturer may say to the public utility man, "Well, your prices are fixed by law; there is no price cutting." After all there isn't a great deal of difference in the importance of each industry's problems. It is true that heavy chemicals are necessary to the production of most manufactured goods. These chemicals, in their original state, are rarely sold to the ultimate consumer. They are raw material contained in or assisting in the manufacture of other products.

In many cases price is not an important factor in the cost of the finished article. Glaubers salt constitutes a small part of the cost of a yard of finished suiting. The costs of sulphate of alumina in making paper and of oil of vitriol in pickling wire are relatively unimportant, yet the aggregate tonnage constitutes the business of the chemical producer. Obeying the law of supply and demand, we find in many cases the chemical manufacturer, like some of his fellow business men, selling below cost and acting as if he liked it. A great proportion of chemicals is sold under yearly contracts. When a producer finds his stock increasing because his customers' requirements are not what they used to be, he has only one thing to do: stop manufacturing. He cannot run a "one cent sale." His customers have no place to put large supplies of chemicals, especially acids; so, regardless of price, they cannot take more than they can use.

It is often the case that the chemical manufacturer cannot shut down because his product is the result of an operation which must continue in order to produce for a contract for another product of the operation. The simplest example of the necessity for plant balance is the production of muriatic acid from salt and oil of vitriol. If a producer has contracts for 10,000 tons of muriatic he must find a market for approximately an equal tonnage of salt cake. If his market happens to be the Canadian sulphate pulp trade and Canada puts on a prohibitive duty on salt cake, he has a problem, because he has to continue to produce the muriatic. There isn't space enough here to discuss the dozens of problems that seem fundamental to the sale of heavy chemicals.

We find the sales departments of the companies confronted with the task of selling large tonnages of low-cost products in a competitive market in which freight, packaging, and handling constitute a large portion of the consumer's cost. Products which do not lend themselves to storing must be sent from the plant in an even flow, regardless of the fluctuating requirements of customers. The material must be sold to consumers whose low inventory requirements and need for prompt delivery service are becoming more exacting.

During the last decade there has been a flourishing era in the building of large and efficient plants. Low-cost production has been the aim of management. They seem to think that low-cost production alone is the foundation of success. To that end have engineers and chemists labored. Research and management have striven to put their plant on a cost basis comparable with any competitor. The raw materials, power, labor, plant overhead, taxes, insurance, and depreciation accounts have been analyzed with scientific minuteness, and the result has been worth the effort. The industry is made up of new or renewed plants for the manufacture of chemicals at low costs per unit. Probably there have been cases of overdoing low-cost production, of spending larger sums than were warranted and junking greater values than the results merited to attain a position on a competitive level with others. During it all, sales and merchandising have been partially neglected; at least they were of secondary importance. The old method of selling continued with but little change.

We are now passing into another era; the emphasis will be placed on salesmanship and merchandising. The industry is ready to produce. Now it must sell its products. Merchandising methods have outgrown the peddling days of the past. The chemical industry has not always been abreast of the times in changing its methods. The sale of heavy chemicals has not materially changed since the latter part of the last century. Most of the companies send their men over the country, selling their "lines," trying to interest textile mills, soap factories, wire-drawing plants, battery stations, laundries, and a hundred other possible customers in a list of products manufactured by the "house." A change in these methods will be brought about by the demands of the customers and by the methods of competitors.

It is assumed that a sales department has the full and necessary information regarding products, their relative importance and earning power, markets, freights—in short, the knowledge upon which a sales organization must func-

tion. There are two types of work that must be handled: the actual selling, on the one hand; salesmanship, distribution, advertising and servicing; and on the other hand, the machinery of handling the sales after they are made. The latter includes such work as handling orders, packaging, freights, shipping, pricing, billing, and collecting.

Salesmanship—To keep abreast of the times it will be necessary to specialize in the sale of certain classes of chemicals. A basic technical knowledge of products; why they are used; how they react, will have to be part of the "stock in trade" of every successful chemical salesman. In the past, a salesman's activities have not been concentrated on the goal of selling one product thoroughly. He has had but little opportunity for constructive salesmanship, suggesting new uses to customers, and new products to his company. He has been an order taker.

Two Newer Plans

Two newer plans present themselves. One method is to sell by products; for example, one man should have charge of heavy acids, one of alumina salts, one of sodium compounds, one of ammonia, etc. Each one of these men responsible for certain products may concentrate with the expectation that the company will gain through the concentration of effort. The market for each product could be thoroughly covered. By the use of this method difficulties may arise. For instance, a textile mill would be called upon by the representative of the acid department, the sodium salts, ammonia, and possibly many other departments. Cost of sales would be greatly increased. Confusion would arise in the minds of the buyers as to with which salesman any particular matter should be discussed. The larger chemical companies produce many chemicals. Their sales forces cannot maintain steady pressure on each product, and the result is that they do not do as well as a competing company whose entire business is in the manufacture of one product.

A second method is more logical and cheaper and has the advantage of concentrated effort. This method is selling by industries. By dividing the markets into industries, such as paper, steel, textile, rubber, and leather, etc., and by putting a man in charge of each industry, there is gained the desired specialization and a full knowledge of the industry as far as its chemical needs are concerned. The cost of selling is somewhat increased, but the extra cost should be more than compensated by the increase in sales, the introduction of new products, and by the better service rendered its customers, by fewer complaints, and a more thorough understanding of the use of the products. The department may be organized so that senior salesmen have charge of the industries. The work of junior salesmen is distributed according to territory. When an industry becomes important enough to the company to put a man in charge it should be done.

Distribution—By study of freights and distribution costs, available territory may be mapped. Distribution may be undertaken by the company's agencies and warehouses, or by jobbers and distributors. Jobbers and distributors have a definite place in efficient distribution. When a jobber can buy in carloads and distribute in less than carload quantities more cheaply and conveniently than the distribution could be accomplished by the producing company he is doing a real service. He is entitled to his commissions and to the overage he can obtain on the price of small quantities over the lower "carload" prices. When a distributor or jobber can represent a company in a territory (generally distant from the company's plants) more cheaply than the company could be represented by opening an office or sending its salesmen, the jobber is doing a service.

Selling Through Jobbers

The chemical industry formerly sold through jobbers to a much larger extent than at present. From that custom there have come down many cases of companies selling to jobbers located in their own cities, paying the jobber a substantial percentage of the selling price for the business of large consumers in the proximity of the producer's plant. A waste is created; the consumer could order directly; the delay of putting orders through a jobber would be done away with; one set of bookkeeping entries could be eliminated. In certain cases the middleman is not entitled to his commission. The producing company's salesmen should handle the business.

Servicing—There is one member of a sales organization whose importance is beginning to be realized more and more. For lack of a better name we call him the sales service man. His position has grown out of the "complaint chaser's" job. In the organization necessary to a progressive company he is the technician who coordinates the work of the sales department with that of production; smooths out the technical difficulties which arise between the customers' needs and the producers' practices. He gives ideas to research and development departments for improvements and for new products; he suggests to salesmen possibilities of new uses. Complaint chasing may still be his tool for becoming acquainted with the chemical and other technical problems of the customers. His position will be an increasingly important one in the personnel of all sales departments.

How the attitude of customers has changed toward him! A few years ago a certain service man approached a textile mill official, suggesting the use of a chemical which would materially reduce the cost of dyeing. He was told that the textile mill had operated successfully for half a century and when the advice of a young chemist was needed to carry it on the service man would be called upon. Four years later the textile man said, "If you can show us how to do anything cheaper, or if you can recommend anything to squirt on cotton cloth to sell the cotton, you can have the mill to work with as long as you wish." The textile mill in one detail at least was four years too late in changing its attitude. Likewise, the chemical company not building up its sales service department is delaying one important step in its progress.

After the actual sales have been made, packaging, freight, and pricing are the important functions of a sales department.

Packaging—With changing conditions the industry must look more closely to the problem of packages to carry chemicals from producer to consumer. Great advances have been made in carboys. The old wool-packed box is a thing of the past; lighter, stronger carboys are used, but much work is to be done in order to eliminate the use of glass in transportation. The consumer is seeking a constant flow of chemicals to his plant; he does not wish to build up inventories. An economic unit for acid delivery is the tank truck if deliveries are made within a 40-mile radius of a plant. Railroad tank cars will carry the larger quantity and there is a tendency to increase the size of the car. The chemical industry has been accustomed to the use of second-hand barrels, drums, bags, etc. This is passing. One-trip steel drums, fiber drums, new wooden barrels, and bags are taking the place of the heterogeneous supply of second-hand alcohol drums; whiskey, flour and sugar barrels; and grain bags once used. As new containers can be made more cheaply they will supersede the old. On account of their efficiency and appearance, they result in fewer complaints and better satisfaction.

Exchange of Tonnage

Freights—Industrial chemicals are relatively cheap products. Freight costs are a large part of the total. It is a rule of thumb in competitive areas such as the eastern part of the United States that for each ten dollars in selling price of a product it could be shipped economically for one hundred miles. Competition within the economic shipping zone of a competitor has been impossible or at least unprofitable. There is a great opportunity in the industry to allocate business so that large freight charges—which to the chemical manufacturer and his customer are economic losses—can be avoided. Tonnage of each company in the territory of another should be exchanged; the industry would be saved heavy haulage charges. Under the existing statutes this would be illegal,

but perhaps the future will bring changes in our laws which will put an end to business restriction.

Pricing—Factors entering the determination of price are: first, cost, including overhead, plus a fair profit; and, second, competition. In the latter case the competitor makes the price; others may meet it or lose the business. There are few heavy chemicals in the class of specialties—products which carry a high percentage of profit and which are free from competition; products which demand high prices on account of some inherent advantage. The heavy-chemical industry sells necessities, low-priced and competitive. But the Sherman and the Clayton acts make it illegal for competitors to allocate territory and to agree upon price schedules. How much more constructive it would be if the laws allowed the establishment of associations for fixing just prices according to conditions within the industry! The association's activities should be reviewed by the government in order to prevent exploitation. The price cutter should be punished as a destroyer of economic values rather than encouraged, as he now is, to the detriment of the welfare of the industry. The greatest gift of the Congress to the industries of the country would be the abolishment of the outworn anti-trust laws.

It has been a custom in American business to give a discount of 1 per cent for the payment of bills within ten days, a custom which undoubtedly arose in the days when industry was made up of companies whose credit was not large enough to do their business and who needed the money. The cash discount has been abused so that discounts are demanded for payment on the tenth prox., 30 days, and so on. The whole system is merely dressed-up price cutting! Funds in a bank earn 1 per cent per year; therefore, in allowing 1 per cent for ten days' payment, instead of net cash in 30 days, the seller is paying 1 per cent for each 20 days' use of money. As he gets for it only one-eighteenth of one per cent, he is paying 18 per cent a year! It is pleasing to know that the custom is slowly being discarded.

Analyzing Distribution Costs

By D. A. WILCOX

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DISTRIBUTION costs in chemical industry may represent a high or low percentage of the total cost of conducting a business—ranging all the way from 40 per cent of the sales dollar down to 15 per cent. Nor is the total distribution cost only that amount which the manufacturer bears. Thus if a company makes but a few products and sells its entire output through one broker or jobber, the management may believe that it has a very low distribution cost. The truth is that the greater part of the cost of distributing its products is borne by the factor, and this, in turn, is passed back to the manufacturer in the form of lower prices paid for his products. No matter how the goods are sold, the manufacturer is intimately concerned with the total spread between the price which he receives and that paid by the ultimate consumer.

It is obvious that the nature of the product will have a direct bearing on the cost of distributing it. Articles sold in bulk and practically direct to the consumer, such as sulphuric acid, will cost less than products of small size requiring individual containers, greater advertising, and the expense of a large sales force.

Finally, sales volume and general business conditions will have a decided effect upon distribution costs. Unlike most factory operations, distribution costs increase per unit as the volume increases. This is due to the mounting sales resistance as the manufacturer approaches the saturation point of the market. Thus when a new product is introduced which has great merit it may practically sell itself, but as the supply begins to catch up with the demand it becomes more and more difficult to move each succeeding unit. This means more work on the part of the sales force, more advertising and higher costs, which mount up out of proportion to the increase in volume.

In any attempt to analyze distribution costs and thus get them under control, it is first necessary to know all the points to look for and the factors which may affect them. Thus we have the manner in which distribution is secured. Is it direct to the consumer or must the product be sold by intermediaries or even at retail? The normal quantity of each sale is an important element. If we sell in tank-car lots, that is one thing, but if we sell in pound lots we have a decidedly different story. Then we have the question of inventories and stocks which we must maintain in order to give service.

The first step in securing a control is to list these factors. To control costs we must first analyze them, but before we can do that we must have a clear understanding of all the things which enter into them. In starting an analysis of distribution costs preparatory to setting up a control, we should, then, study our product, its physical properties, the manner of its use, the method of sale, the normal unit quantity of sale, the matter of transportation and anything else which might have a bearing on the cost of distributing it.

It frequently happens that many of the elements of distribution costs are of a general nature and cannot be definitely assigned to any one particular product or group of products. How are these costs to be prorated over the entire line so that each unit gets a fair share? There are two ways in which this can be approached. One is to assume some arbitrary method of proration which seems fair and the other is to avoid any attempt to prorate them at all. In the latter case we merely consider these expenses as a lump sum in the cost of doing business, or rather as a general selling expense, deducting them from the profits after all the direct charges have been distributed.

Distribution costs, like any other costs, can be controlled only by two steps: the first is to know what they are, and the second is to know what they should be. Control is secured by measuring results against standards. In attempting to control distribution costs we should make a careful analysis of them; arrange them in logical classifications; and then set standards, either in total if they be of a general nature, or by units of product if they vary that way. Then, having our standards, we can make comparisons between them and the actual costs.

To some extent this may be done mechanically; that is to say, we can set up standards for total costs (however arrived at) for certain classifications and then regularly subtract these standards from the actual totals obtained in the same way. If the actual costs exceed the standard costs there will result a positive figure which will show the excess; if the actual costs be less than the standards we will get a negative figure, or credit, and this will indicate that all is well.

As a mechanical arrangement this is excellent, but we cannot control merely by reports and figures. In no sense of the word can accounting, or any system of automatic flagging, take the place of management.

Chemical engineers may be well advised in wondering whether or not production costs should bear the brunt of the depression, They can very properly ask how good a control their company has of distribution costs—in fact, whether or not anything is being done to reduce the costs to distribute the products which they have labored so hard to make at a minimum of cost—up to the mill door!

Volume vs. Selective Merchandising

By R. G. CASWELL

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AFTER COMPLETING a doctorate thesis in organic chemistry and physics at Brown University in 1914, the author of this article spent four years in a university research laboratory. He then entered the employ of the du Pont company where an equal period was given over to the development of manufacturing processes for dyestuffs and intermediates. His next work as head of the W. B. Pratt laboratory at Newtonville, Mass., gave him an insight as a consultant into the research and development problems of the rubber and paper industries. In June, 1925, he resigned to become development engineer for the Hood Rubber Co., and after two years in experimental production and accounting work, was given full charge of a plant division at Watertown, Mass. In February, 1930, he took over the direction of industrial research for Bigelow, Kent, Willard & Co., Inc. Here his broad experience, so well reflected in this article, is being applied in market and merchandising studies as well as in the direction of technical research for a number of his company's clients in process industries.

SOME TWENTY YEARS AGO, or thereabouts, when many of us who are now fairly within that long and flat era known as the middle age were then callow youth, our perspective in relation to the factors that went to make up the cost of industrial marketing was limited by general conceptions of direct and administrative sales expense, transportation charges, and the costs of promotional and advertising efforts. If we could develop a product which, in the flattering terminology of patent literature, really constituted a "useful invention," or, though not new, was of superior quality, and was, moreover, producible at an economic manufacturing cost, it followed as a corollary that some way could be devised to sell it.

To this view, the manufacturing organization, dominating and controlling the situation in respect to research and development activities, gave its ready assent, and almost invariably put pressure to bear on the sales department to accomplish this end. At length, supported by a long period of upward business trend, manufacturing came to be firmly settled in the driver's seat, with consequent forcing of markets. In this situation the slogan, if such existed, may well have been: "We can make it; let's sell it."

It is no more than a platitude to state that for some time the very converse of this conception has more nearly represented the truth, which is to say, "We can sell it; therefore, let's produce it." With the trend now strongly set in a downward direction the continuance of a policy of forcing a market with resultant excessive costs of distribution is felt to be positively unsound business. From which it logically follows that, to be economically operated, an industry must be dominated less and less by its manufacturing function and more and more by its distribution organization. Under these changed conditions the problem has gradually become that of the location and working of those markets in which a natural demand exists, and more specifically, the determination of the really profitable strata of those markets.

A further complicating consideration in respect to the optimum balance in emphasis between the manufacturing and distribution functions in their bearing on the costs of distribution, is that most senior executives have obtained the major fraction of their experience under conditions essentially different from those that now exist.

For some time the situation with which industry has been confronted in this respect is summarized by the statement that whereas in 1920, approximately 60 cents of the consumer's dollar went to the manufacturer and 40 cents was needed for selling and distribution, in less than a decade this ratio was virtually reversed. During 1929-30 the breakdown of the consumer's dollar showed 41.2 cents to production and 58.8 cents to selling and distribution. These figures were derived from a study of costs of 81 index companies. The fraction going to the manufacturer excludes all selling expense either to the manufacturer or to subsequent channels of distribution, the selling expense being put in the cost of distribution.*

A study of the principal financial ratios of some sixty different industries over a period of several years, in many instances representing an examination of the ratios of fifty concerns within a single industry, yielded some pertinent data in relation to what is economic and what is not, within any given industry. Obviously, normal ranges for particular ratios were found to vary considerably with location, size of business, type of product; and within certain industries, as anticipated, there would be observed variations associated with the quality and unit size of product marketed, as, for example, for coarse paper mills and fine paper mills.

In all studies of this character, whether carried on by an outside organization from a detached point of view or by the management of a single concern in cooperation with the several members of its own industry, one conclusion stood out that is of predominat-

*Acknowledgment for use of data is made to Carle M. Bigelow, president, Bigelow, Kent, Willard & Co., Inc., Boston, Mass., in an article, "Is There a Cure for Uneconomic Prices and Abnormal Selling Costs?" in *Sales Management*, Feb. 7, 1930.

BY A CHEMICAL ENGINEER FOR CHEMICAL ENGINEERS, BUT FROM THE VIEWPOINT OF DISTRIBUTION RATHER THAN PRODUCTION

ing importance. This is the factor of sales volume. Generations before any organized attempts were made to correlate information by the interpretation of financial ratios, men knew intuitively that "volume" was one of the vital factors, if not the vital factor, that determined the ability of the business to return an adequate profit on the total capital employed. It is a well-known fact that for most concerns this crossover point, or point at which losses end and profits begin, lies somewhere between 33⅓ and 50 per cent of capacity. These relationships, when set up as a chart, have long served as a graphic representation of the status of a business as a profit-making entity.

Volume and More Volume

This conception of "volume" as prerequisite to the profitability of a business became a cardinal principle in the thought of executives until, by and large, the attainment of "volume," limited only by considerations of customer credit, was little short of "the be-all and end-all" of management. To this conception the manufacturing function was entirely sympathetic, since it was demonstrably true that manufacturing costs were lowered with increased production. At length, with both the producing and distributing functions of business in agreement on this point, the stage was all set for a general *laissez-faire* policy of forcing of markets, with its many ramifications in competitive pricing, sales promotional campaigns, wasteful advertising, instalment buying, and what not.

The era of post-war deflation, which became acute in the depression of 1921, served as an educational factor of tremendous importance to the purely manufacturing functions; and those, caught with excessive inventories, recognized the necessity of reducing to a minimum their backlog of raw materials, stock in process, and finished merchandise against orders. But with the resumption of a condition of normalcy in domestic trade, on which was superimposed a marked rise in demand for export, the race was forthwith on in the forcing of markets. It will be recalled in this connection that the first indication denoting the approach of the present depression was the rapid curtailment in our export trade.

It is our thought that, generally speaking, the "volume" idea still dominates, and that during these months of shrinking sales increased pressure has been applied to market, more or less indiscriminately, in the attempt to restore and maintain "volume." It goes without saying that this thing, if workable, is justifiable. Otherwise, it is undeniably a factor of increased cost of distribution, without compensating advantage.

Within our observation and contacts, those companies which during this period have been able to maintain a profit, or have gone only slightly "in the red," notwithstanding a marked falling off in sales, have been characterized by the astuteness with which they have scrutinized the costs of their customer accounts, which study in a formal way forms the basis of selective merchandising.

This necessity for determining very exactly the point at which the profitability of an account ends has been brought about by a gradual change in buying habits, which at the present time are close to a hand-to-mouth condition and are based on the principle of keeping physical inventories at a minimum. Twenty years ago, when a young chemical engineer needed to purchase two 24-in. pipe wrenches, he in all likelihood requisitioned three, for which action he incurred no hazard of being censured, since the safeguarding of production was of vital importance. Today, in a similar situation, he would be more likely to purchase one, and obtain the other by hook or crook, or go without. To purchase three wrenches during this era of retrenchment, when the actual need might be argued down to one and one-half, would be considered little short of commitment of sabotage on his own job.

This change in buying habits, whether in the service of the manufacturer, or by the purchaser of finished merchandise, is reflected in an upward trend in the costs of distribution, and specifically in respect to the cost of small orders. In one manufacturing group closely allied to the chemical industry, the average size of the dollar value of orders received has fallen from $262 in 1927 to $216 in 1928 and 1929, with further decrease to $167 in 1930, and the current rate is barely $155. In another instance within this same period, average value per order has gradually decreased from $300 to $75—approximately. This condition in buying is so general that carloads may be said to have yielded in large measure to barrel shipments, or units of equivalent size, and where the latter were formerly ordered, to broken container lots.

The situation is not greatly affected by the large customers, who, although buying against closely budgeted production schedules, continue to purchase through contract orders, on which there is a relatively low distribution expense to the manufacturer, and also to him a correspondingly small margin of profit. It is to the very great number of medium and small volume customers that the steadily decreasing dollar value of orders is to be attributed. This condition in its bearing on the costs of distribution is illustrated by the case of a manufacturer some 40 per cent of whose production is in commercial acids and heavy chemicals marketed through negotiated sale; the major fraction of his sales volume lies in fine chemicals and pigments, distributed through salesmen. In this 60 per cent of his total volume, approximately four-fifths of the orders received do not exceed $10 per order. A somewhat more marked case is furnished by a manufacturer of organic and inorganic chemicals, including a comprehensive line of pharmaceuticals, aggregating some 2,000 items, of which some 30 per cent of the orders received lie between $3 and $5 per order. The chemical and allied industries are no more exempt from this condition of downward trend in the size of orders than the manufacturers of split rivets or fountain pens.

In these circumstances the determination of the profitability of the small order becomes primarily a problem of finding out what the small order actually costs; and, secondarily, the cost of distribution to customers whose annual volume is below that which can be handled at a profit. Here is where one phase of the technique of selective merchandising may enter the picture with promising results.

Attacking the Problem

Obviously, the problem is not attacked from the standpoint of product profitability, although data on this point are indicative of trends. Similarly, the average cost of distribution, expressed as a percentage of the sales dollar, is an unsatisfactory and misleading index of profitability, since this is no more than a figure derived from the profit and loss statement and, therefore, yields no picture of the profitability of any particular account or groups of accounts. This condition would be illustrated by the hypothetical case of a manufacturer the product profitability of whose items ranged from 6.4 per cent to 11 per cent, and 40 per cent of whose net sales, equivalent to $1,600,000, approximately, lay within the class of small shipments to customers handling small annual volumes.

A preliminary analysis of profitability within this class of business yielded the following breakdown: 48 per cent of the dollar value of sales was made at a profit of 16 per cent; 25 per cent resulted in 4 per cent profit; and the remaining 27 per cent of business was carried out at a loss of 8 per cent.

In this instance manufacturing cost was not a factor of profitability, since this class of business represented pri-

Breakdown of the 40 Per Cent of Sales

48%	$768,000	16% Profit	$122,880 Profit
25%	400,000	4% Profit	16,000 Profit
27%	432,000	8% Loss	34,560 Loss
	$1,600,000	6.5% Profit	$104,320 Profit

Result of Applying Selective Merchandising in a Typical Plant

The first six months of 1928 before application revealed the following:

Group	Annual Sales Per Customer	No. of Accounts	Sales	Mfg. Cost and Adm. Exp.	Selling Expense Amount	Selling Expense Per Cent	Profit Amount	Profit Per Cent
I	$50,000+	9	$639,822.11	$473,468.36	$71,020.26	11.1	$95,333.49	14.9
II	$10,000–$50,000	26	963,021.62	712,636.00	131,933.96	13.7	118,451.66	12.3
III	$1,000–$10,000	186	1,119,637.34	828,531.63	261,995.14	23.4	29,110.57	2.6
IV	$1–$1,000	811	321,461.19	237,881.28	119,583.56	37.2	*36,003.65**	*11.2**
	Total..........	1,032	$3,043,942.26	$2,252,517.27	$584,532.92	19.2	$206,892.0[illegible]	6.8

* Deficit.

The first six months of 1929 in the same plant after application:

All Customers....	322	$2,286,717.82	$1,742,478.99	$322,427.21	14.1	$221,811.63	9.7

marily the same manufactured items that were marketed to large customers comprising the major fraction of the company's business. The increased factor of distribution expense, which determined the line of demarcation between the profitable and the non-profitable order, as illustrated above, is very evident from data obtained in a recent study, drawn purposely from another industry, of the items of expense in the handling of small orders.

Following an intensive study* it was determined that the cost of quoting amounted to $1.26 per order, to which was added a cost of $0.67 for entering the production order and $0.64 for invoicing and billing, yielding a total of $2.57 for clerical work necessary to handle the order. This minimum expense was the same for an order representing a $10 shipment as for one that could be invoiced at $1,000. To this charge of $2.57 for paper work must be added the direct selling expense of $4.60, the prorated average cost per salesman's call. Here is an illuminating corollary on the cost of small orders.

With the trend definitely set toward smaller orders, it is plain that the manufacturer, by and large, cannot categorically refuse acceptance. Withal, the small order of today is often a step to the large volume of next year. But in this situation there is a definite "stop loss" limit, and to ascertain this limit the manufacturer, as a matter of self-protection, can obtain for his own particular conditions of marketing, accurate and adequate information. The problem is defined by a study of customer profitability, in which the breakdown of the items that comprise selling expense is by groups of customers, in relation to unit size of orders, to annual volume, to clerical work required to execute orders, to efforts necessary to consummate sale, to territories, and in some instances to the expense of technical sales service. Not infrequently knowledge of the line between profitable and unprofitable business has required that the study be extended even to individual customers.

Surpassing in boldness the knight who set his lance in rest and charged the windmill is he who at this time would herald his advent by the announcement that he assuredly could increase a company's sales, come one, come all. For the present situation is better defined by the oft-repeated observation of Judge Brack in the closing lines of "Hedda Gabler," "People don't do such things." And an assertion even more preposterous would be that it might conceivably be a factor of increased profitability to reduce sales. But the application of the art of selective merchandising, which embodies the principles of research fully as much as those investigations in the fields of chemistry and engineering, has incontrovertibly demonstrated that many companies are selling in part where they should not, and in part to whom they should not.

It is one problem to operate a business profitably on reduced income; it is another to predetermine to reduce the income to increase profitability. This apparently epigrammatic statement represents not at all a condition of paradox. In a recent study made by a manufacturer merchandising in the Minnesota territory, it was learned that he was operating unprofitably in that area, from which he withdrew, with consequent shrinkage in his sales volume of some 20 per cent. But the result of this action was an appreciable increase in profits in dollars.

The limitations of this article prevent the introduction of much detail in the discussion of illustrations of customer analyses in their bearing on profitability. In the case presented here, which is felt to be fairly typical, actual figures are given, with due care to conceal the identity of the manufacturer and his products. In this industry output is in part direct to manufacturers, but largely to consumers through salesmen; none to jobbers. The tabulation indicates the total sales volume grouped by classes of customers, together with the distribution expense apportioned to the respective groups. It pictures clearly that an adequate profit is obtained only on annual sales to an account of not less than $10,000. For this particular manufacturer, sales to customers within the range of $1,000 to $10,000 per annum were carried out at little better than a break-even point, with consequent inadequate return on sales volume and failure to justify the capital employed. On annual sales not exceeding $1,000, selling expense both actual and percentage, approximated that in Group II. The 811 customers in Group IV incurred substantially as great a selling expense as the 26 customers in Group II; and Group IV showed an actual loss of some $36,000, or 15 per cent of the total profit.

As the result of these findings, and following further breakdown of the original groupings represented in the tabulation, no additional solicitation was made to unprofitable accounts. The condition of affairs one year later is given by the data summarized in the lower section of the table. Total sales volume was lowered by approximately three-quarters of a million dollars. An increase of $15,000 in actual profit was obtained, with further improvement in position, not shown in the table, by elimination of some $350,000 of capital employed.

The illustration given above is typical of the results of a persistent use of the principles of selective merchandising in providing accurate information as to the really profitable strata of market in application to the conditions of a particular business. The weighted average as an index of the degree of profitability of an industry is far from satisfactory, and yields little or no measure of control of the factors that constitute the cost of distribution.

Much has been written on the subject of market analysis and development. Other phases of selective merchandising include the organization of external and internal sales activities; incentive compensation plans, not only for salesmen but also for sales executives; the design and installation of sales records and statistics; and the set-up of sales quotas and budgets of selling expense. All of these things are very important factors in the control and reduction of the costs of distribution, but are obviously quite beyond the scope of this article.

It is our thought in this connection that the chemical engineer may well devote a fair fraction of his interest to the economics of the industry to which he belongs, inasmuch as it appears that in the future the distribution function will of necessity occupy a position much more important than heretofore in determining the policies of management.

*Acknowledgment for use of data is made to J. A. Willard, treasurer of Bigelow, Kent, Willard & Co., Inc., in an address on the "Cost of Small Orders," before the Paperboard Industries Association, Nov. 19, 1930.

Planned Promotion for Technical Sales

By R. S. McBRIDE
Editorial Representative
Chem. & Met.

PROFITABLE selling policies spring from the product. The close of the World War ushered in an era of surpluses; thereupon, management, with overextended production tools on its hands, was slowly aroused to the fact that the ability of markets to consume limited in a very real fashion the magnitude of manufacturing operations, either of individual companies or of an industry as a whole. Able to produce products in great profusion, it became increasingly difficult to meet the ever more exacting requirements of dictatorial markets.

Out of this condition has grown a healthy recognition for market research which, in its basic simplicity, is nothing more or less than the definition of the needs and the scope of consumer groups. Market research thus becomes the first step in planned sales promotion and presents quite as imposing a challenge to the chemical engineer with executive responsibilities as does the technique of production operations.

In the ideal set-up, market research might well precede even the building and equipping of a plant. In a crude sense this has always happened, of course. Companies have been formed to manufacture some product for which there existed a proved or a supposed demand. But today, with production facilities already provided, management can approach the ideal only in the launching of new products. The other and more frequently recurring problem is to make older products more suitable to the needs of users and to search out new uses and markets for them.

Obviously, commercial research is a technical task of no mean proportions. It comprehends not only a selection of the markets to be cultivated and the invention or improvement of products to meet the requirements of those markets but also a careful study of the types of men who are the most important buying factors and of the selling appeals that can favorably influence them toward the product offered for sale.

These functions of commercial research are in the nature of continuous processes. Market needs change and with them may change the uses of a product. New and unsuspected outlets suddenly manifest themselves. Products are sold, and their capacities in actual use must be studied. Competition complicates the market problem and economic conditions necessitate the reshaping of sales appeals and strategy. Market research, although including the necessary task of diligently gathering every discoverable fact directly or indirectly related to the production, properties or applications of a product, has the deeper objective of appraising present and forecasting future uses and requirements.

The Promotion Staff

The individual responsible for this important promotional groundwork should cultivate very definitely the fact-finding or research viewpoint in his approach to the multifarious problems involved. The optimism of the sales manager and salesman has no place here, although information gleaned by the sales force will flow into the factual files of the "information unit," just as every fact, figure or opinion which comes to any member of the company's staff becomes raw material for the market resarch mill. The responsible director of the market research and product information unit faces the dual necessity of enlisting the cooperation of other functionaries within his own company and winning the confidence and good will of the company's customers. He must be tactful and resourceful as well as capable of facing the inherent facts of a market situation even when they are negative to the sales manager's enthusiasm. He must be a thorough organizer, for collected facts acquire usefulness only as they are properly related to specific problems and are made readily available.

The cost of an effective market research set-up is difficult to estimate. Salaries of director and staff capable of executing a carefully organized plan of procedure, traveling expenses, occasional work of a specialized nature constitute the chief items. Since the work of this department is not only fundamental to planned promotion but also contributory to the successful manufacture of the product, its cost might well be shared by the production function. It is sometimes included wholly or in part in the product research budget.

These brief suggestions of the scope of market research need not discourage the smaller manufacturer. Although the essential nature of the work be-

This and subsequent charts from "Industrial Advertising at Work," McGraw-Hill Publishing Co.

Splitting the 1931 Industrial Advertising Dollar

	Per Cent
Business & Trade Papers (space)	44.49
Artwork, Engravings (for advts.)	9.63
Sales and Service Literature (except direct mail)	10.86
Direct Mail	12.62
House Organs	2.85
Conventions, Exhibits	3.46
Movies and Photography	0.34
Administration (incl. salaries)	9.29
Price Lists and Internal Publications	1.28
Miscellaneous (radio, local and general papers, etc.)	5.18

comes more and more obvious as the difficulties of selling increase, there are today available many sources of helpful information that involve little or no expense. Industrial publications and the national and some state departments of commerce and census reports are examples, as well as the effective work of some outside commercial research organizations. Resourceful management, whether it be in large or small enterprises, will find many inexpensive sources of aid.

The next steps in planned promotion turn the findings of market research into gold. This, of course, is the final objective and comprehends the use of advertising, publicity, public relations, and physical selling activities. The accumulative force of these activities is concentrated on the production of profitable sales in sufficient volume to keep the plant producing at the highest possible rate. The idea of sales promotion does not include generally the physical selling function—i.e., the activities of salesmen in the field—and we will so limit it for the purposes of this discussion, although actually the technical salesman is called upon to contribute considerably to the effectiveness of promotion service. Promotion work must be planned and carried out in close coordination with and for the support of sales effort.

Selling demands day-to-day planning of calls on individuals, follow up of inquiries and everlasting attention to details, with single customer orders as the result. The promotion plan, on the other hand, although involving a certain degree of flexibility, must be on a more extended scale, for only long-time methods can be expected to succeed. Promotion planned on the basis of the single customer is rarely economical. It becomes so specialized in appeal as to be impractical of use in a sufficiently broad manner. The promotion manager lays in the background with broad, bold strokes, and the sales manager fills in the detail with orders and contracts.

The Place of Advertising

Advertising is the most active accelerator of sales promotion. Properly planned and executed, its force is broad and fast. The various forms of publicity and public relations contribute to its effectiveness, particularly in the cultivation of market areas where special attention can be profitably concentrated. Its everlasting objective is to win a sympathetic or at least an impartial hearing for the sales story of the product throughout the length and breadth and depth of a market.

The chemical engineer may be able to contribute only indirectly to such details as space buying and printing, but his technical judgment of what goes into the space is greatly to be desired. Publication copy, literature for use by salesmen at conventions or for direct mail, must be technically accurate and useful in the sense of contributing definitely to a sound appreciation of the product's utility. The advertising of technical products can hope to increase in effectiveness only as the chemical engineer more willingly and freely and frankly opens his mind to the man charged with the important function of sales promotion. Obviously, this cooperation must be based on understanding and it behooves the technical executive to seek a comprehension of all promotion functions.

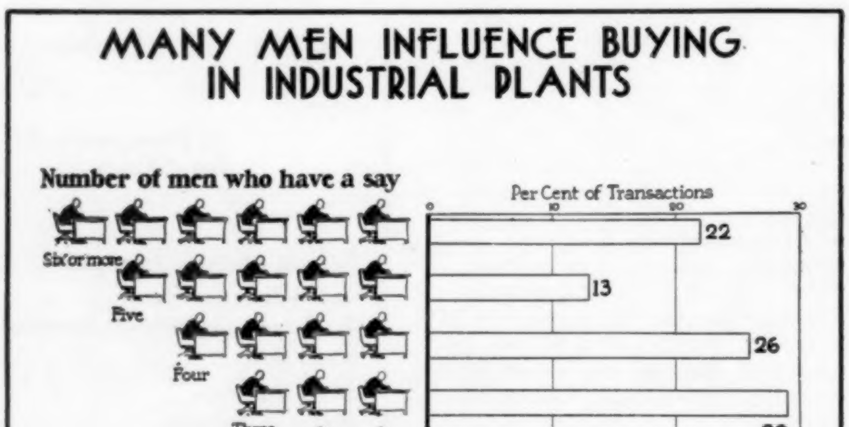
Despite the possible indirectness of his aid in the selection of publications and other conveyances of advertising, it will benefit the engineer to realize that this detail necessitates intensive study of the research department's conclusions on markets and on the buying practices of those markets. For example, a metal or other material of construction sold to a wide variety of industrial users may be most successfully merchandised only when the advertising is planned to reach designers of equipment, operating officials, production executives, and even certain classes of subordinates. The designer must know the characteristics of the particular material; the operator must be satisfied that it will suit him in the plant; the executive must appreciate the economy of its use and the subordinate must be so well convinced of its utility that he will not, intentionally or inadvertently, throw the proverbial monkey wrench into the promotion machine as it starts to grind out sales.

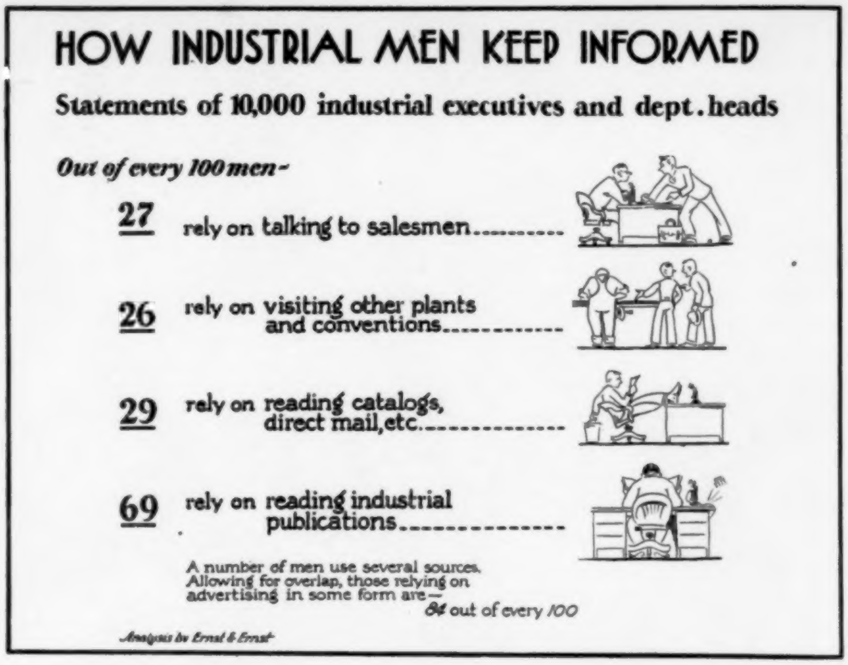
Effective conviction of the several types of men who influence buying in most industrial markets is a matter requiring constant promotion effort. Usually it is not worth while to advertise at all in a particular field or in a particular publication unless a long-time and regular program is adhered to. Furthermore, it is rarely economical to undertake advertising unless the advertiser properly provides for adequate and prompt support in the matter of handling inquiries by additional information, by the calls of salesmen, and by other forms of cooperation.

Other Printed Media

Direct mail and other types of corporate literature are indispensable parts of any complete promotion plan. Such promotion material assumes almost as many forms as there are products to be sold. Wisely managed plans utilize everything from letterheads to the little slips that accompany dividend checks as means of building up favorable opinion.

A house organ is only a specialized variety of corporation literature sent at more or less regular intervals to those believed to be interested in the subject matter. To edit properly a private magazine of this nature requires a thorough knowledge of the field served and more than a little ability in the selecting of material and in editorial make-up. It is vital to the success of a house organ that before launching it a careful study be made of the availability of suitable material at sufficiently frequent intervals. No other misfortune is greater than having the date of issue approach only to discover a dearth or complete lack of fitting material. Such an event sets everyone from president to office boy scurrying about





to remedy the deficiency. The indirect cost of disturbed management under such circumstances may exceed greatly the measurable direct costs of producing the pamphlet. Issuance on a trial basis, "occasionally as and when desired," is a much safer method than regular periodical appearance without exceedingly careful consideration of long-time problems inevitably involved in the publication of any magazine, whether house organ or commercial in nature.

As already suggested, publicity and public relations may assist materially in leveling up the low spots of an industrial market. The most commonly recognized forms of publicity are news releases, photographs and technical write-ups intended for editorial use in regular publications or for the use of lecturers, book authors and others who become the agents of further dissemination. Its major objective is to furnish information which will stimulate interest and confidence in the products of a company, through other than paid advertising channels.

Such publicity has outgrown to a large extent the more notorious practices that at one time reduced propaganda of all forms to regrettably discreditable circumstances in the eyes of editors and public alike. Properly conceived from the viewpoint of honest and constructive assistance to the technical reader, this method of promotion becomes of indubitable value.

The use of motion pictures is frequently considered within the publicity category of the promotion plan. Motion pictures sometimes assume great importance as a means of showing methods of manufacture and demonstrating operating achievements. When a suitable film library has been built up, a loan system may be established which will extend the field of service of this tool to include certain phases of the educational, association and customer cooperation activities of the public relations function. If a company maintains eight or ten films, perhaps two or three copies of the more popular ones, a few hundred dollars a year will take care of the loan service to those groups or institutions where their use becomes an important factor in building company recognition, and even in achieving the more tangible results of inquiries and orders.

Public Relations Work

Public relations work is too frequently the most haphazard of the promotion activities of most companies. Without definite programing, attempted cooperation with customers, educational institutions and technical associations or committees may become a burdensome load on any company. Furthermore, careless execution usually turns well-intended efforts at outside cooperation into a boomerang which cuts back with unexpected and tragic force to sorely bruise the corporate anatomy.

Almost every company renders to its customers a considerable amount of service without direct charge. This may extend beyond the limits of correspondence and conference to rather elaborate experimental projects or joint trials of products or processes. In so far as such work is experimental in nature, experience suggests the wisdom of placing it under the director of research or the development engineer. But this activity, being essentially promotional, is usually subject to the advisory supervision of the promotion manager or the promotion commitee. If for no other reason, such an arrangement insures timeliness of effort.

The value of cooperation with educational institutions is less widely understood. Many companies fail to realize that familiarization of student engineers in the use of their products, though not immediately productive of sales, exerts a long-time favorable influence hard to build up by any other means.

Promotion Budgets

The costs of commercial research have already been considered. The costs incident to the other promotional functions are governed by so many factors that their proper budgeting is truly a matter of special concern to each individual company. Their budgeting, however, is just as feasible as the budgeting of manufacturing operations, and just as necessary for effective control. The starting point of any adequate promotional budget lies in a careful consideration of the sales objectives of the company. Very frequently an arbitrary appropriation is apportioned to these activities and the suit cut to fit the cloth, however quick it fits the job to be accomplished. Planned promotion demands the fairest possible answer to the question, How much can we spend for promotional and sales effort before the law of diminishing return begins to cut into its effectiveness? If the answer to that question were diligently and continually sought after by American industrial companies, great benefit would acrue to their individual and collective health.

Products which must be advertised to a wide range of potential customers necessarily require much larger advertising budgets than those sold within limited fields. Publication advertising costs vary widely with the list of periodicals used, but $2,500 to $3,000 a year will buy space in the leading monthly publications and $5,000 to $6,000 a year in the leading weeklies, on the basis of a page an issue.

Copy, design, and other preparation, including photographs and art work, commonly cost a substantial additional sum. Fifty dollars for preparation costs probably is a minimum for good copy on technical subjects; $100 is a safer average. The cost will be two or more times this average for color or especially fine art work. One large advertiser, doing a wide variety of technical promotion work, estimates that it costs him $5,000 a year for a series of twelve different advertisements in the more worth-while technical markets. Such a figure probably is typical if it includes preparation of copy, incidental expenses and purchase of space in the most effective monthly periodical in the field. The figure is too low for regular full-page use in weekly papers, and possibly too high if the same advertising copy is used in several periodicals. From $2,000 to $3,000 a year generally covers the addition of a second monthly of quality, using the same copy.

This brief summary of publication advertising costs suggests that the preparation item necessitates a careful

study of the rates, coverage, and copy service of individual periodicals. Many advertisers find it economical not only to seek the aid of the publishers whose magazines they use but also to retain the services of a competent advertising agency.

The cost of direct-mail and corporation literature involves three major items: first, preparation of copy; second, engravings and printing; and third, the cost of distribution, which usually is the largest item of all, although it is sometimes quite overlooked in budgeting this promotion function. In one recent case a company undertook the preparation of a series of technical bulletins describing its various products and their uses. It was found that one particularly capable member of the promotion department could prepare some twenty such items a year at an average cost of about $250 for each pamphlet of four to twelve pages. The printing cost for the booklets in the quantity required was estimated to be about $500 each. But it turned out that twenty booklets, costing approximately $15,000 for preparation and printing, required nearly this much more money for mailing lists, stockroom, envelopes, postage and mailing services. The aggregate of approximately $30,000 a year for this single promotional effort consumed more than 10 per cent of this particular company's promotion budget.

House organ costs range widely according to elaborateness of preparation and frequency of issue. To prepare a monthly of sixteen pages and attractive color, with generous use of illustrations and occasional use of color on the cover, usually costs not less than $10,000 a year for distribution to a limited mailing list. For the more elaborate types going to large mailing lists, say 10,000 or more, it is not unusual to have a house organ reach the cost of $25,000 a year. According to the N.I.A.A. findings, 15 per cent of the average promotional budget goes for direct mail advertising, including house organs.

Publicity work ranges in cost all the way from next to nothing, when most of the material comes from men of the company regularly engaged with other work, to several thousands a year, when this activity is projected on a scale that requires special editorial personnel and necessary assistance. The N.I.A.A. average budget sets the cost of motion pictures and photographs at about 1 per cent of the budget. The actual cost of films giving a 10 to 15-minute showing is modest; skilled promotion departments are able to produce and execute short-run scenarios at from $300 to $500 each.

Public relations is another budget item of great variability. If it is cast up on the grand scale, it will run into many thousands of dollars. On the other hand, cooperative service work in most companies is budgeted to the department in which the men doing the work are regularly employed. Hence promotion budgets usually make very little allowance for convention or committee activity except for that which relates to exhibits or expositions. Some very fine show results are obtained for as little as $500 plus the traveling expenses of representatives. Often, however, much money is spent in the preparation of exhibit material, ornamentation and various forms of customer entertainment. Generalization regarding such costs is, of course, impracticable. The typical promotion budget will include funds for such purposes, however, and the N.I.A.A. regards about 4 per cent as the average.

General or administration expense for promotion work is inevitable, varying according to the ambitions of the adopted program. Merely the items of rent, stationery and routine operating expenses are significant. But the salaries of the promotion manager and his major assistants, if any, are dominant considerations. A competent promotion manager is in all events an economy, not an occasion of increased cost. Attempting to have someone "double in brass" on advertising and publicity, as one advertising man puts it, is not necessarily an economy. Avoiding this, of course, means trained and capable assistants, while in the smaller company it may be necessary and desirable for one man to handle the whole promotion job. Ten per cent of the promotion budget probably is necessary for administration expense.

Inaugurating a Program

Initiating a promotion program is not a difficult matter. It is not necessary to committ a corporation to any large-scale initial expenditure, although a complete budget is always desirable, at least as an objective toward which the work will develop. One company, in recently undertaking an enlarged promotion program, adopted the ingenious scheme of fixing a budget objective without authorization of the complete schedule at the start. The promotion manager was instructed gradually to organize the work, adding, as circumstances justified, the several activities which were to be incorporated in the whole. The management anticipate that eighteen months or two years may be required to reach the rate of expenditure which they believe will be amply justified by the task to be accomplished. They regarded an attempt to start everything at once as folly and chose the flexible budget system to enable them to feel their way along and consolidate their gains as they came.

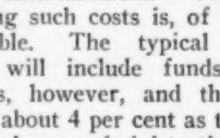
Planned promotion is doomed to failure if it is set up as a thing apart. Profitable sales promotion policies spring from the product itself. Only recognition of the fact by the management and by every member of the executive staff that the promotion and sales functions are as integral and inseparable parts of company operations as the purchasing department or the production department can provide any sound basis of success. Products are made to be sold at a profit, and profits have suffered inconceivably in the past because the almightly problem of putting products into the hands of users has been refused the sustained and serious consideration of technical minds. In the process industries the chemical engineer can, and will be called upon increasingly to, cooperate with the promotion executive. The problems concerned are complex and challenging, and only the surface possibilities of planned promotion have been scratched.

FINAL RESULTS SHOW WHETHER • • •
ADVERTISING IS EFFECTIVELY USED •

Some good indicators:

Trend of sales
Trend of sales compared with sales of the "industry"
Trend of stability of sales (month by month)
Trend of selling cost
Trend of size of orders
Trend of total sales per salesman
Number of inquiries received
Sales to plants not called on by salesmen
Reputation among buyers
(measurable by a recognition survey)

Only a thorough "cost accounting" of the sales process will enable most efficient control of salesmen and advertising.



Packing and Shipping Chemicals

A SYMPOSIUM

Course of Development

By WARREN N. WATSON
Secretary, Manufacturing Chemists' Association
Washington, D. C.

CONTRIBUTORS to this symposium are among the engineers who have made it possible for the development of chemical shipping containers to keep apace with the progress of the chemical industry itself. As secretary of the Manufacturing Chemists' Association, Warren N. Watson has had much to do with the development and standardization of containers for the transportation of chemicals. Maurice F. Crass is chairman of the association's carboy committee and of the poisonous articles and miscellaneous package committee. His experience also includes the management of package control for the Grasselli Chemical Co. T. P. Callahan, of the Merrimac Chemical Co., Inc., a subsidiary of the Monsanto Chemical Co., is actively engaged in the container work of the association. He is chairman of the committee dealing with steel barrels and drums. And Raymond C. Pierce writes with authority on the advantages of transporting various types of chemicals in bulk, due to knowledge gained as vice-president in charge of engineering and research for the General American Tank Car Corp.

IT REQUIRES only a superficial examination of the great variety of authorized containers for chemicals now in use to appreciate that progress in the development of chemical shipping containers has kept apace with the progress of the chemical industry itself. In the early days of the American chemical industry the entire list of containers comprised glass-balloon flasks and wooden barrels and boxes. Later came the sheet-iron and steel drums. Today the number of chemical containers is so great and the specifications and differentiations so complex that this field is a specialty within the chemical industry; in fact, many chemical firms maintain a special container department, while in others a single man is delegated to the supervision and maintenance of a single kind of container. Common practice, however, for the smaller firms and certain of the larger firms is to merge the container department with the traffic department.

Most of us are familiar with the 103-A tank car and the 5-A drum for the shipment of sulphuric acid. It is doubtful, however, if executives and chemists of the greatest foresight could have predicted a decade ago that muriatic acid would be shipped in rubber-lined steel tank cars or nitric acid in alloy drums, and the remarkable progress in the manufacture of high-pressure tank cars for the shipment of chlorine, ammonia, and other gases has had far-reaching effects on the economics of the producing and consuming chemical fields. The history of the development of any one of our modern chemical containers covers a period of extensive and intensive investigation. Due to the hazards of forwarding containers, tests and experiments must be unusually thorough and cover an ample period of time.

In the 60 years of its life the Manufacturing Chemists' Association has played a leading part in the development and perfecting of containers. Safety has always been placed ahead of other interests, including those of economy, and while it is true that more economical containers are being developed, the record of transportation accidents demonstrates the highly creditable advances in the interests of safety.

The association has found it necessary to divide the container-research work among special committees. In addition to a traffic committee we have one devoted exclusively to steel barrels and drums, another to carboys, one to tank cars, and still another to miscellaneous packages and poisonous articles. A continuous program of research is under way in each of these committees on technical and economic problems involved in the development of new containers and standardization of those already in use.

The regulatory history of the shipment of hazardous chemicals is of interest: In 1906, the Bureau of Explosives was organized by the carriers to make regulations covering the transportation of explosives and dangerous articles in the interest of reducing the hazards of their transportation. This organization now acts in an advisory capacity to the Interstate Commerce Commission and polices the shipment of dangerous articles by rail, functioning principally along the lines of inspection and instruction.

The act of May, 1908, specifically authorized the Interstate Commerce Commission to issue regulations covering the transportation of explosives. Authorization was not included to issue regulations for dangerous articles other than explosives. The act of March 4, 1909, continued the provisions of the act of 1908 relating to the issuance of regulations for explosives. In the meanwhile the I.C.C., under Section 15, and beginning in 1911, could suspend practices of carriers which were not lawful or satisfactory.

The act of March 4, 1921, in Sections 232 to 236, authorized the commission to issue regulations for explosives and allied products and also dangerous articles, including inflammable liquids and solids, oxidizing materials, corrosive liquids, compressed gases, and poisonous articles. Sections 235 and 236 provide penalties for violation of the provisions of this act or of the regulations of the I.C.C.

Regulations are revised from time to time in the way of a general revision and also by adding supplements. A complete revision was made effective Oct. 1, 1930, and the official copy includes 381 pages of regulations for the transportation of explosives and other dangerous articles by freight and express, and in baggage service, including specifications for shipping containers. This is binding on all common carriers engaged in interstate or foreign commerce by rail and upon all persons making shipments via such carriers. Poisonous articles are specifically dealt with in these regulations in the way of classification under three groups, with provisions for labels and with minute specifications for containers.

Approval by the I.C.C. of a new container for a hazardous product or the adoption of an amendment to one of the existing regulations involves a lengthy procedure, which includes hearings before the Bureau of Explosives, followed by hearings before the Interstate Commerce Commission. For many years the technical committees of the Manufacturing Chemists' Association have had cordial relations with the Bureau of Explosives, and many of the bureau's technical problems are referred to these committees for investigation and opinion.

Containers and Shipping Instructions

Chemicals	Estimated % Shipped in Tank Car or Bulk in Car	Tank Cars	Bulk in Cars	Steel Drums and Cylinders	Wooden Barrels	Kegs and Casks	Carboys
Acetic Acid	70	Aluminum		100 gal. ret. aluminum drums	50 gal. non-ret. 400, 450 lb.		5, 12 gal.
Acetone	60	8,000, 10,000, 12,000 gal steel		70, 350, 650, 700 lb. drums	350 lb		
Aluminum Sulphate	50		×		221, 350, 500 lb.	100 lb. keg.	
Ammonia, Anhydrous (*b*)	80	I. C. C. 105A, 50,000 lb. high pressure		50, 100, 150 lb. cylinder			
Ammonium Sulphate	80		×		300, 400 lb.	100 lb. keg	
Arsenic, White	25	8 ,000 gal. steel				50, 100, 220 lb. keg 500-550 lb. cask	
Barium Chloride					400 lb.	100 lb. keg 800-1,000 lb. cask	
Benzol	90	8,000-10,000 gal.		55, 110 gal. ret. drum			
Bleaching Powder				115, 300, 350, 800, 924 lb. non-ret. drum. 400, 550 lb. galv. non-ret. drum for export	400 lb.		
Borax					300-370 lb. U. S. P. 200-250 lb. C. P.¶	100 lb. keg	
Butyl Acetate		×		50, 100 gal. ret. drum			
Butyl Alcohol	75	8,000, 10,000 gal. steel		50, 100 gal. iron drum			
Calcium Carbide		...		100, 220 lb. non-ret. drum		100 lb. keg	
Carbon Bisulphide	40	8,000 gal. steel		5, 10, 55 gal. drum			
Carbon Tetrachloride	75	8,000 gal. steel		60, 120, 700, 1,400 lb. ret. drum			
Chlorine (*b*)	80	Single unit of 30,000, 60,000 lb. multi-unit of 15 one-ton units		100, 150, 2,000 lb. steel cylinder			
Chromic Acid				100, 400 lb. non-ret.			
Copperas					400-425 lb.	100 lb. keg	
Copper Sulphate					450 lb.	110, 220 lb. keg	
Epsom Salts					350 lb.	100 lb. keg	
Ethyl Acetate	30	8,000 gal. steel		50, 100 gal. ret. drum			
Ethyl Alcohol	50	8,000 gal. steel		50, 55, 100 gal. ret. drum	50 gal.		
Formaldehyde	20	8,000 gal. aluminum or rubber-lined		450, 475, 1,000 lb. aluminum-lined ret. drum	450 lb.	60, 125, 200 lb. keg	100 lb
Glaubers Salts					350 lb.	100 lb. keg	
Hydrochloric Acid	50	6,000, 8,000 gal. rubber-lined					12 gal. 5 gal.
Lead Carbonate					500, 600 lb.	12½, 25, 50, 100 lb. keg	
Lime	25		×	180 lb. non-ret. drum	180 lb. 200, 300, 400 lb.		
Methanol	60 (*c*)	8,000, 10,000 gal. steel		55, 100 gal. ret. drum	50 gal.	55, 110 gal. keg	
Naphthalene					175, 200 lb.		
Nitric Acid	80	Chrome-steel or chrome-steel lined					70, 140 lb. certain strengths
Phenol	60	8,000 steel: C. P. in aluminum		112, 240, 475, 875 lb. non-ret. drum			
Phosphoric Acid	80	Rubber-lined		50 gal. rubber-lined ret. drum	50 gal. compounded wood	12 gal. compounded wood keg	5, 12 gal. Tech. 70 lb. Tech. and U.S.P.
Potassium Carbonate					400 lb.	100 lb. keg. 600, 800, 900, 1,100, 1,500 lb. cask	
Potassium Prussiate					350 lb.	100 lb. keg 500 lb. cask	
Pyrites			×		900 lb.	500 lb. keg	
Salt Cake			×		500 lb.		
Soda Ash			×		450, 500 lb. dense, 300 lb. light	100 lb. light in keg	
Sodium Bicarbonate			×		300, 400 lb.	112 lb. keg	
Sodium Bichromate		...			300 lb.	100 lb. keg 700 lb. cask	
Sodium Bisulphate			×		250, 500 lb.	100 lb. keg	
Sodium Chlorate						112 lb. wooden keg	
Sodium Hydroxide	20	8,000 gal. steel, nickel-lined for iron free		50, 400, 700 lb. non-ret. drum	55 lb. flake		
Sodium Nitrate							
Sodium Phosphates					325 lb.	125 lb. keg	
Sodium Silicate	60	8,000 gal. steel		55, 100 ret. drum 30, 50 gal. non-ret. drum	600 lb. lump 56 gal. solution		
Sulphur			Crude		155, 500 lb. refined		
Sulphur Dioxide (*b*)	60	40,000 lb. I. C. C. 105A		Ton drum on multi-unit cars. 2, 6, 8, 10, 25, 70, 100, 120, 150 lb. cylinder			
Sulphuric Acid	85	8,000, 10,000, 12,000 gal. steel or lead-lined				400, 750, 1,600 lb. keg	170 lb.
Tartaric Acid					224, 240, 300, 550 lb.	100, 112 lb. keg	
Zinc Oxide					100, 400 lb.	100 lb. keg. U. S. P. 100, 220 lb. cask, Tech.	

(*a*) No label exemption of exception is permitted whatever. (*b*) See *Chem. & Met.* Sept., 1930, p. 584 for classification of authorized transportation containers for all comp. and liquid gases. (*c*) Of refined. (*d*) 50° Bé basis. (*e*) Acetic acid requires white acid label and classes as corrosive liquid when express shipment but not freight.

for Fifty Typical Chemicals

Bags	Cans	Bottles and Jugs	Boxes and Cases	Shipping Instructions (g) I. C. C. Classification	Kind or Color of Label Required (h)	Chemicals
		5 gal. jug various bottles		(e)	(e)	Acetic Acid
	Various			Inflammable liquid	Red	Acetone
200 lb. burlap			25 lb.			Aluminum Sulphate
				Compressed gas	Green, gas	Ammonia, Anhydrous
100,200 lb. burlap. Paper (for export)			25 lb.			Ammonium Sulphate
			25 lb. 100, 220 lb. case	Poison	Poison	Arsenic, White
200 lb. cloth			25 lb.			Barium Chloride
	Various			Inflammable liquid	Red	Benzol
	25 lb.		25 lb.			Bleaching Powder
300 lb.	1.5 lb.		25, 50 lb.			Borax
	1.5 gal.					Butyl Acetate
	1.5. gal. crated			Inflammable liquid	Red	Butyl Alcohol
						Calcium Carbide
	1.5. lb.	1.5 lb. bottle		Inflammable liquid	Red	Carbon Bisulphide
	Various					Carbon Tetrachloride
				Compressed gas	Green, gas	Chlorine
	1.5 lb. U. S. P. 25 lb. tech.	1.5 lb. bottle U. S. P.	100, 200 lb. case, tech.	Oxidizing material	Yellow	Chromic Acid
200 lb.	1.5. lb.	1.5 lb. bottle	25 lb.			Copperas
		1.5 lb. bottle	25, 50 lb.			Copper Sulphate
125 lb. burlap 100 lb. cloth, asphalt-paper lined	Various		10, 25, 50 lb.			Epsom Salts
	1.5 gal.			Inflammable liquid	Red	Ethyl Acetate
	1.5 gal.	Absolute and 95% in bottles		Inflammable liquid	Red	Ethyl Alcohol
						Formaldehyde
200, 220 lb.			25 lb.			Glaubers Salts
		¼, 1, 2, 6 lb. bottles		Corrosive liquid	White, acid	Hydrochloric Acid
						Lead Carbonate
10, 25, 35, 40, 50 lb. paper 90 lb. paper-lined jute						Lime
	1, 2, 3, 5, 10 gal.	Various bottles		Inflammable liquid	Red	Methanol
200 lb. paper crude						Naphthalene
		Various		Corrosive liquid	White, acid (a)	Nitric Acid
				Poison	Poison	Phenol
		1.5 lb. bottle, tech. 1, 5, 10 lb. bottle, U. S. P.				Phosphoric Acid
		1, 5 lb. bottle	25 lb. 100, 200 lb. case			Potassium Carbonate
		1, 5 lb. bottle	25 lb.	(f)	(f)	Potassium Prussiate
			100 lb.			Pyrites
200 lb.						Salt Cake
300 lb. dense 200, 300 lb. light			25, 100, 275 lb. dense 25 lb. light			Soda Ash
200 lb. burlap 200, 300 lb. paper-lined			5, 25, 50 lb.			Sodium Bicarbonate
	1, 5 lb.	1, 5 lb. bottle	25 lb.			Sodium Bichromate
		1, 5 lb. bottle				Sodium Bisulphate
		1, 5 lb. bottle	1, 5 lb. carton, 25 lb.	Oxidizing material	Yellow	Sodium Chlorate
	5, 10 lb. U. S. P. and 25 lb. Tech.	1 lb. bottle U. S. P. and C. P. 1, 5 lb. bottle solution		Corrosive liquid if in sol.	White, acid	Sodium Hydroxide
100, 200 lb. paper				Oxidizing material	Yellow	Sodium Nitrate
200 lb. paper						Sodium Phosphates
600 lb. lump						Sodium Silicate
50, 100 lb. paper 100 lb. burlap						Sulphur
				Compressed gas	Green, gas	Sulphur Dioxide
		Various bottles and jugs		Corrosive liquid	White, acid	Sulphuric Acid
		1 oz., ¼, 1 lb. bottle	1 lb. carton 5, 25, 50 lb.			Tartaric Acid
lb. paper, Tech.						Zinc Oxide

(f) Poison if KCN is meant; otherwise specify yellow or red for $K_3 Fe_2 Cn_6$ $K_3 Fe Cr_6$. (g) See regulations for transportation of explosives and other dangerous articles as issued by I.C.C. for further details. (h) Placards are also required on cars. (i) Certain strengths only. (X) Shipped in.

Containers for Every Need

By M. F. CRASS
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PACKAGING of solid and liquid chemicals affords a problem interesting in its diversity. Before selecting a package the nature of the chemical and its peculiar requirements must be known.

Consider the mineral acids. No two of them can be treated alike. Each has properties which must be considered in providing a safe carrying container. Sulphuric acid in concentrations of 60 deg. Bé. and greater can be safely transported in steel. For lower strengths, corrosion is progressively increased as the strength of acid is reduced. For muriatic acid, glass carboys are still used in large numbers. However, the art of bonding rubber to steel has in late years been perfected to such a degree that rubber-lined steel tanks have largely replaced the use of wood. No known metal is suitable as an unlined unit for packaging this acid. The shipment of nitric acid has until recently been largely confined to glass containers. Recent research has demonstrated that aluminum will successfully resist corrosion for concentrations over 80 per cent HNO_3; also chrome-nickel alloys are being successfully used where the chlorine and sulphuric acid content do not exceed certain limits.

Some chemical solids are hygroscopic. Unless the package selected is fairly moisture-proof, atmospheric humidity will impair the physical condition of the material and under certain conditions seriously affect its value. Many other chemicals are deliquescent at certain temperatures. For such products, a package must be provided which will either drain off or retain the liquor, according to the requirements of the case.

Protective interior linings such as asphalt and paraffin are provided where the corrosive nature of the chemical requires it. Plugs, gaskets, and seals must be carefully chosen, and all factors tending to impair the purity of product must be guarded against continually. These are indicative of the difficulties encountered. Package selection for a chemical must meet the special necessities of the case.

Because of these and other factors, the cost of containers in some services is so great in proportion to the value of the product that returnable units must be provided; for such, an invoice charge is made for the package. A credit (usually for the same amount as the debit) is made upon its return in good condition. When the package is suitable to the commodity carried, its long continued use makes possible its gradual amortization. Obviously, the package cost per trip is inversely proportional to the trips made.

There has been consistent endeavor to improve the strength and carrying qualities of packages. This development represents an interesting chapter in the history of the industry. Since the introduction and general use of the standardized testing machine required by Interstate Commerce Commission Specification 1-A, there has been a definite improvement in the average condition and shock-resisting strength of the boxed carboy. Careful investigation into thickness of glass, shape and capacity has resulted in a much improved bottle. Many different types of packing are used, the requirement being that

Car Consists of 28 Manganese-Steel Cylinders Carrying 225,000 Cu.Ft. of Helium Gas

a boxed carboy filled with water must withstand a 55 in. swing test, side and bottom; a well conditioned carboy with at least 1 in. space between the side wall of bottle and box should pass this test. The variable mold and gallonage of carboy bottles in circulation has resulted in boxes of different size, making interchange difficult. A serious attempt is now being made to determine the factors necessary to produce the strongest possible bottle, the goal being a standardized carboy bottle of uniform size box for general use.

The standard 5-pint glass-stoppered bottle is a satisfactory carrying unit with the exception of the seal; the stopper usually is secured by means of a plaster cast incased in paraffined muslin. This seal is difficult to break and contamination of product may result if insufficient care is exercised in its removal. An interesting development now nearing completion consists of an inside screw closure, so designed as to insure purity of product, and yet easy of placement and removal.

The best types of fiber drums provide strong and nearly air-tight containers, almost ideally suited to the requirement of most dry chemicals. Leakproof construction at all joints, with a well-fitting, strongly secured cover, practically eliminates the dusting loss sometimes present in multiple-joint wood packages.

If the nature of the chemical is such as to attack the fiber interior, remedy can frequently be found through impregnating the fiber wall with paraffin, asphalt or resin, which treatment also has a water-proofing effect. This type of package, procurable in almost any size, compares favorably in cost with wood, and usually is cheaper than steel, notably in sizes less than 30 gal. capacity. For the shipment of certain products known as class B poisons this package is now available, and reference can be found under I.C.C. Specification 21-A for freight shipments.

Paper bags in which the weight of contents usually is limited to 50 lb., are being used in larger volume each year. Products for which this package can be used are rather limited and shipments are largely confined to carload lots. Smaller paper bags packed in outside containers are largely used where the low price of the product requires a low-price container. The Consolidated Freight Classification should be consulted for permissible right to ship in this type of package.

Many chemicals are classed as regulatory merchandise and may be included in one of the following classifications: explosives, corrosives, inflammables, or poisons. For such, the packages selected must conform to I.C.C. regulations and specifications for shipment by freight or express. It is mandatory that the shipper carefully observe these federal transportation requirements, both for his own and the public's protection. Damage and transportation loss claims have been and are being largely reduced through conformity with these reasonable and wise regulations. It is true the choice of containers for regulatory articles is limited and defined; nevertheless, the regulations are of unquestioned value to industry in guiding selection to safe and proper packages. Every proposed regulation and specification is made the subject of careful study before adoption, giving shippers assurance of safe practice in each case.

The sales value of a well-conditioned and good appearing package should not be overlooked. For barrels and single-trip light-gage drums the paint scheme can be made attractive at slight cost. Painting the head a different color from the body is effective. The importance of clean, clear stenciling needs only to

be mentioned; blurred or poorly applied stenciling should not be tolerated.

Steel drums are being used in larger volume each year. Single-trip drums of light-gage metal usually are cheaper than a package of corresponding strength in wood. Such a package is suitable for many chemicals, both liquid and solid. Where a light, fluffy product is shipped, a much more rigid drum body can be obtained without increasing the gage of steel by adding corrugations above and below the center of the side sheet. For such a package, a well-conceived color scheme with the paint baked on, giving the appearance of an enamel finish, adds greatly to its appearance.

Improvement in appearance and carrying value can frequently be obtained without added cost. In one case a liquid product was merchandised in boxed cans. It was found that a considerable portion of the trade would accept drums. This change gave a stronger, better appearing package at one-half the cost. Jacketed cans replaced by small steel drums of the same capacity gave a more sturdy and attractive package at less cost and reduced the freight charges one-half by obtaining a fourth-class rating instead of first.

The wooden barrel is one of the most used shipping containers. Through the organization of the Associated Cooperage Industries of America, standardization of materials, construction, and sizes of containers has been accomplished. And through its two committees, on grade rules and specifications for tight cooperage and slack materials, the industry cooperates with other national organizations such as the Bureau of Explosives, Bureau of Standards, and Freight Container Bureau of the American Railway Association, many of whose specifications have to be drawn in accordance with the rules of the I.C.C.

Various kinds of barrels are available for wet or dry, light or heavy products. Among the features of this type of container is the low conductance of heat, which is advantageous in the case of combustible or perishable products. External moisture only seals the barrel tighter due to expansion of wood. Because of the bilge it is a convenient package to handle.

The life of the wooden barrel is a cost factor to be considered, as with reasonable care, it can withstand the stress of multiple trips. A used barrel has a sales value and can usually be returned to the shipper or disposed of locally at a fair salvage value.

A careful review of complaints from the trade will show a large proportion arising from leakage in transit, also contamination and loss of product arising from damaged containers. Railroad statistics on damage claims show a large annual loss. If intelligence and effort proportionate to that given to production entered generally in the selection and conditioning of carrying units, a large step forward would be made in insuring safe delivery of products.

Shipping in Steel

By T. P. CALLAHAN

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STEEL containers are recognized as being indispensable for many shipping purposes. In compactness, ease of handling, guarantee against breakage or leakage, the steel container is particularly advantageous. The steady increase in the use of metal containers during the past ten years for the handling of chemical products has been much more rapid than the growth of the chemical industry.

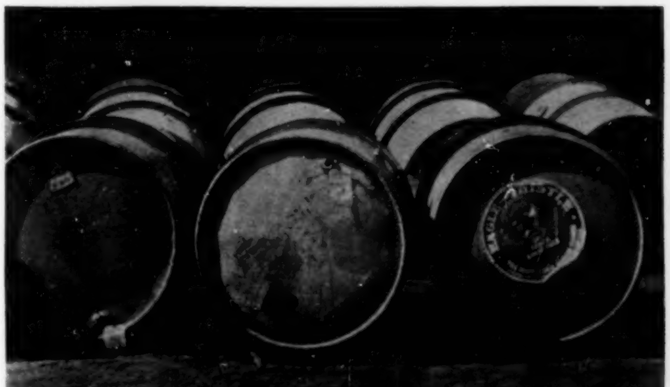
A fundamental of barrel manufacturing is standardization. The use of standard types and sizes of containers is economically sound and of real convenience. Unfortunately, some manufacturers and consumers, from selfish motives, will not adopt the standards approved by the barrel manufacturers.

In accordance with the unanimous action of the joint conference of representatives of manufacturers and users of steel barrels and drums held on March 26, 1924, the U. S. Department of Commerce, through the Bureau of Standards, recommended the recognized sizes of steel barrels and drums to be produced in the following capacities as:

Standard light shipping drums, wine gal. 10, 15, 30, 55.
Standard I.C.C. drums, wine gal. 10, 15, 33, 55, 110.
Friction cover, light drums, wine gal. 10, 15, 33, 40, 50, 55, 60.
Bolted cover, light drums, wine gal. 10, 15, 30, 40, 50, 55, 60.
Bilge barrels, wine gal. 55.

On Jan. 1, 1925, the steel-barrel and drum industry, in cooperation with the Department of Commerce, entered into a program of simplified practice. The purpose of this program was mainly to reduce the number of types and sizes in which steel barrels and drums were being made. It was expected that centralizing demands on fewer varieties would result in smaller inventories being carried and other manufacturing economies effected. Due to developments in the use of steel barrels and drums as shipping containers, it has been impossible to adhere fully to the standard capacities agreed upon. Nevertheless, results have been encouraging and savings have been passed on to the users.

One of the many important activities of the Interstate Commerce Commission has been development of specifications for shipping containers. This is particularly true in transportation of inflammables, explosives, corrosives, and materials that could injure other shipments and cause damage and heavy claims. The containers for shipment of such articles include steel barrels and drums. Users of these types of containers for shipment of explosives, inflammables, and other dangerous articles must protect themselves by getting barrels that fully comply with the I.C.C. requirements, because all penalties inflicted for the use of improper packages fall upon the user of the barrels and not the manufacturer of the package. The user of a package not made in compliance with the I.C.C. regulations is subject to heavy penalties, but the maker of the package is not liable. Misbranding of barrels themselves is the only count on which package manufacturers can suffer penalties. The so-called act



Steel Drums for the Shipment of Aqua Ammonia

of March 4, 1921, provides fines of from $2,000 to $10,000 and/or imprisonment of from 18 months to 10 years for violations of the regulations of the I.C.C.

Dangerous articles requiring shipping containers made according to I.C.C. specifications for their transportation by common carriers are divided into five groups: *i.e.*, explosives, inflammable liquids and solids, oxidizing materials, corrosive liquids, and poisonous articles.

As stated above, it is important to select the proper type of shipping container for chemical products and other less dangerous articles. Considering these facts I am enumerating ten factors of importance in selecting the proper type of shipping container: (1) I.C.C. regulations on transportation restriction; (2) action of the products on the material of the container, corrosion; (3) safety; (4) strength to resist damage to the product; (5) design; (6) ease of loading and filling; (7) ease of unloading and emptying; (8) appearance; (9) cost; and (10) ease of cleaning and reconditioning.

The Interstate Commerce Commission has worked out a set of regulations governing the transportation of chemicals and other products which limit the selection of containers suitable for any specific product. In addition, some thought must be given to the transportation conditions to which the containers will be subjected.

Usually, containers are purchased with the intention of using them as so-called public carriers, but there are cases where containers are used solely in the handling of the product during its process of manufacture. Because of the corrosive action of many chemical products, the second point mentioned above becomes important. At the present time, steel containers are available not only in the usual steel finish but also in the following special finishing: galvanized, terne coated, pure tin, and rubber-lined. In addition, chrome-nickel and other alloy steels are offered in standard sizes and shapes, as also are aluminum-alloy packages. Rather extensive tests have been conducted for some years to determine the action of certain acid and chemical products on these different types of materials and most chemicals have been classified accordingly. Certain acids and chemicals such as nitrocellulose cotton represent a serious hazard unless packed and handled properly. The safety factor must be considered where products to be handled are dangerous.

As in the case with shipments of almost any product, the chemical manufacturer must study the possible damage to his products through abuse of the container between his plant and his customer. In other words, the package should be strong and sturdy and capable of withstanding severe shocks.

The fifth factor is that of design. The shipper should pay careful attention to the type of head or openings, the capacity most suited for his product, the need for leakproof tightness in transit, and the desirability of an automatic agitator so that the container becomes almost a mixing tank. Steel containers are furnished in both straight-side and bilge shapes. In former cases, hoops are used to facilitate handling.

In considering design one must take into account ease of filling and loading. These points are important in making possible the most economical handling of the product from the shipper's end. Obviously the ease of unloading and emptying must also be taken into consideration, particularly since the good will of the user, or customer, should always be maintained and developed.

In the shipment of products which reach the general public, the value of an attractive package is undisputed. It is a factor of less importance in industrial selling, but a wise shipper will strive to obtain a package which reflects the high quality of his product and of which he need not be ashamed.

In considering cost, the purchase price of different types of containers is closely related to the other nine factors. Nevertheless, the manufacturer must weigh the relative advantage and disadvantage under each of the above specifications, along with the actual quotations which he has received. Fundamentally there are two types of steel containers: those that are used for one trip and are then discarded and those that are returned and used for succeeding trips. The question of insurance, interest on investment, depreciation, cleaning, reconditioning, return freight, higher outgoing freight, clerical and bookkeeping charges must be correlated along with the original cost. Moreover, the customer must be considered, as some are better equipped for the return of containers than others. Because of numerous trips which a returnable container can make, it often proves more economical than the one-time container. In the event that a returnable type of container is used, the shipper must investigate the relative ease of cleaning and reconditioning the package. Cleaning, in the case of many chemicals, is a vital point.

In arriving at the cost of using each type I have considered the following factors:

Non-returnable drums

1. Original cost.
2. Cost of transportation.

Returnable drums

1. Original cost.
2. Cost of transportation.
3. Cost of cleaning and reconditioning.
4. Length of time kept by customer.
5. Number of trips possible.

For the non-returnable drums the original cost is approximately $2.30. The freight is paid by the customer. The only charge to the company is 25c. for transportation to freight terminal, making a total cost per trip of $2.55, or $0.0474 per gal.

In the case of returnable steel barrels or drums the original cost of the I.C.C. 5A drum, which is termed by some shippers as a sulphuric acid drum, is approximately $6.65, as before. The freight is paid by the customer but the company must pay 25c. per drum for transportation to and from terminal.

The cost of container amounts to $1.35 per trip, or $0.00174 per pound based on 775 lb. for a 55-gal. drum. While the life of a sulphuric-acid drum is approximately four years, the cost per pound of acid transported is higher than other less corrosive liquids; e.g., aqua ammonia which shows a depreciated cost, on 110-gal. drums, of only 85c. per trip and the life of an aqua ammonia drum in this service is from 15 to 20 years, which depends upon the manner in which the drum is constructed.

Single and Multiple Unit Cars, for Transportation of Chlorine

Package vs. Bulk Shipments

By RAYMOND C. PIERCE
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MOST industries have been deflated and cut to the limit. But, efficient as many of them are, they are overlooking many possibilities of saving money. One of these is in the shipment of materials. A $3,000 a month saving in the moving of dry commodities is not to be despised. Yet, one oil company has saved that much by changing from package shipments of hydrated lime to bulk shipments of ground quicklime, and with entire safety and hardly any investment.

Liquids have so readily lent themselves to bulk shipments that both raw and finished liquid products are shipped in tank cars. Dry commodities, requiring more equipment for handling in bulk, have lagged behind. But the past year has witnessed a revolution in the shipment of cement in bulk. And soda ash, sulphur, arsenic, and many other dry commodities may now be economically shipped in this manner.

In no field is this development more striking than in the chemical industry. Twenty years ago most acids and alkalis were shipped in glass carboys, metal drums, paraffined bottles, or some other type of small special container. Today, one tank-car manufacturer announces a readiness to build a freight car for any need, and tank cars have been built for the shipment of such diverse commodities as: hydrochloric, sulphuric and acetic acids, dry arsenic, lime, solid and liquid caustic soda, cement, helium, liquefied hydrocarbon gases, molten metal, anhydrous ammonia, dye intermediates, lacquers, paints, animal oils, inks, alcohols, and many other products.

The economic advantages of bulk freight transportation are manifold. The old method of shipping in small containers was expensive not only because of the capital tied up in containers and the extra labor required for loading and unloading but also because the shipper had to pay freight on these containers when they were traveling to their destination and for their return empty. There is a good economic reason for the existence of the approximately 200,000 cars which are now engaged on all the railroads of the United States transporting liquids in bulk.

Some specific instances which can readily be amplified will serve to explain why tank cars are so successful and popular with both consumers and manufacturers of anything that can be pumped. For instance, sodium hydroxide, which is one of the basic chemicals used in soap manufacture, petroleum refining and paper-pulp products, under normal conditions is a dry, white powder and can be shipped as such in barrels loaded into box cars. But, strange though it may seem, a much larger tonnage of sodium hydroxide is shipped as a liquid in tank cars, the solution carrying 50 per cent water. Both the shipper and consumer are justified in paying the extra freight and taking the advantages of tank-car shipment over dry shipment. The actual difference in cost to consumer is $8 per ton when shipped in tank cars, figured on the dry basis.

One of the many discarded business axioms is that the prosperity of a manufacturing community may be gaged by the number of carboys of sulphuric acid used. This is no longer a safe yardstick, for now a large part of that acid arrives via tank cars.

An unusual car operating at a pressure of 2,250 lb. per sq.in. is the tank car for transporting helium to the airships of the U. S. Navy. This car has had considerable publicity because it effects savings in the transportation of helium sufficient to pay for the car in 15 trips. Yet, these cars have sold for over $55,000.

Some of the Savings

Concentrated hydrogen peroxide is one of our newer bulk shipments. A tank car made of aluminum alloy to eliminate all possible contamination has recently been developed. This car has a capacity of 8,000 gal., and if we assume this concentrated hydrogen peroxide is moving from a certain manufacturing plant to a Southern cotton mill, the transportation costs work out as given in accompanying table. And a tank car designed to transport 50,000 lb. of anhydrous ammonia moving between certain points approximately 875 miles apart will save $1,749.90 per trip over shipments of the same quantity of ammonia in cylinders.

Comparative Costs of Transporting Hydrogen Peroxide in Tank Cars and Carboys

	Tank Car Shipments, 8,000 Gal.	Carboy Shipments Basis 8,000 Gal.
Units required	1 tank car	666 carboys
Weight of out bound shipment on which freight is paid	97,600 lb.	140,792 lb.
Freight outbound	$722.24 @ 74c. per 100 lb.	$1,196.73 @ 85c. per 100 lb.
Weight of return shipment on which freight is paid	0	43,290 lb.
Freight return movement	0	$320.35
Freight cost of transporting 8,000 gal.	$722.24	$1,517.08
Saving per trip	$794.84	

With the advent of rayon and its subsequent huge production, acetic acid had to be transported in bulk. This required the development of special aluminum tank cars. Comparing the cost of transporting the acid between certain points, we find that to ship 80,000 lb. of glacial acetic acid in an aluminum tank car costs $464. To ship this quantity in aluminum drums costs $644.88, making a saving of $180.88 for each movement of 80,000 lb. of acid.

The production of chlorine has steadily increased and tank-car shipments of this material are common. Comparing the shipment of 60,000 lb. of chlorine between certain points, and the shipment of this same quantity in steel cylinders carrying 150 lb. of chlorine and weighing when empty 120 lb., we find that in tank cars one shipment costs $624. To ship the same quantity in cylinders costs $1,123.20 outbound, and $446.70 for the returned empty cylinders, making a total charge of $1,569.90. This results in saving $945 per 60,000 lb. of chlorine.

When shipping in cylinders or smaller packages, freight is assessed not only on the lading but also on the weight of the container. In addition, freight on the return movement of the container must be paid, and while the rate generally is lower, the charge for the empty return movement is considerable. Freight charges on a tank-car shipment end when the car is unloaded at destination.

Another factor not to be forgotten is the relatively high labor cost of handling packages, as against low labor cost in handling the materials in bulk. Take the shipment of 60,000 lb. of chlorine as an example. When shipped in carloads, the labor cost for unloading with proper equipment is negligible. This quantity of chlorine shipped in cylinders requires 400 weighing 270 lb. when full, or a total weight of 108,000 lb. When returned, the cylinders weigh 60,000 lb. Anyone familiar with the cost of loading and unloading cars will realize the considerable labor cost in handling tonnage of this amount.

The relatively smaller chance of loss and damage to bulk shipments should be considered. The investment of money in cars as compared to smaller containers generally is less, and the expense of maintaining cars is smaller than in the case of the corresponding volume of containers. Special tank cars for carrying dry commodities are now under development and promise in the future even to eclipse the savings already made by cars for carrying liquids.

Efficient plant management has already worked hard to accomplish great savings in plant operation, and must now turn to the cutting of transportation costs as the next step in the effort to cut over-all costs of products delivered to the consumer, as a means of increasing volume and profits.

Determining Equitable Freight Rates

By HARRY M. MABEY

General Traffic Manager
Mathieson Alkali Works, Inc.
New York City

BEFORE joining Mathieson in 1920, Mr. Mabey spent many years gathering experience in railroad distribution. He was connected with the New York Central lines for 17 years and during the War became superintendent of freight traffic for the Zone Supply Officer in New England. After that he spent two years as consulting transportation engineer.

NEVER, since war times, has the importance of adequate transportation been made so clearly apparent, not only to the industrial executive but to the public at large, as in these past few months. Our railroads, speaking as a nation-wide unit, showed that their revenues were decreasing in an alarming manner, and asked for immediate governmental action that would give them additional revenue of about $600,000,000 per year, to be obtained by a direct increase of 15 per cent in every freight rate in the United States.

Brushing aside, as immaterial in such an emergency, the question of cause, they showed that 1930 freight revenues had dropped nearly $750,000,000 and their passenger revenues nearly $150,000,000 in 1930, as against 1929; that the decrease was continuing at an increasing rate which seriously threatened their ability to provide adequate nation-wide transportation. Two facts are outstanding: the remedy sought was, first, a direct horizontal percentage increase in every freight rate, and, second, a uniform increase throughout the nation. As the Class I railroads originated 1,200,000,000 tons in 1929, this 15 per cent increase would have meant an average increase thereon of 52 cents per ton. It is apparent that such an application of the increase, by percentage, would not affect in equal measure freight rates varying in amount; i.e., a freight rate of $20 per ton would be increased $3, whereas one of $10 per ton would increase but $1.50 per ton; the relationship of the two rates would be changed. A $10 equalization would increase to $11.50 per ton, whereas, had each rate been increased by a flat sum of, say, $2.25 per ton, the $10 equalization would have remained fixed.

In disposing of the railroads' 1931 application for increased revenue, the Commission did not approve of a 15 per cent increase on all freight traffic, but it did grant an increase in freight rates varying in amount as to different groups of products and exempting some traffic from the increase entirely. All commodities in transportation are embraced in six grand divisions, made originally for statistical purposes. In it industry had little or no voice, yet it is readily apparent that through this allocation industry becomes involved.

"Products of agriculture" represented 10 per cent, or about 110,700,000 tons originated in 1930; "Animals and products," 2 per cent, or about 23,100,000 tons. These are defined groups of products and were almost entirely exempted from any increase. "Products of mines" represented 56 per cent, or 642,500,000 tons, and this group was split up—part given an increase of 6 cents per ton, part 12 cents per ton and part the maximum increase of 40 cents per ton. In this grouping are contained many of the raw materials of the chemical industry. A study of the products which have been treated to different rates of increase, with a variance as great as 34 cents per ton, shows apparent discrepancies, from an industrial viewpoint. It represents the best informed judgment of the Commission; that the Commission is not better informed is the fault of industry itself.

"Products of forests" represented 6 per cent of the 1930 revenue tonnage originated, or 69,400,000 tons. This group, in general, was given an increase of 12 cents per ton. "Manufactures and miscellaneous" represented 24 per cent of the 1930 tonnage, or 277,700,000 tons. In this group, a few items only were given an increase of 20 cents per ton; the remainder, the maximum increase of 40 cents per ton. All less-than-carload freight aggregated 2 per cent, or 29.7 million tons and was given the same maximum increase of 40 cents per ton.

Apart entirely from the merit of the difference in increases applied on one article as against another, it is evident that an important principle of rate making is involved: that as the rates upon one product or group of products are lowered, those upon some other group must be increased sufficiently to supply the necessary aggregate revenue. It follows that an industry having a common interest in a large group of the same or similar raw or processed materials is vitally concerned in the equitable application of this principle in the general level of freight rates upon those products. In recognition of such a common interest, the Manufacturing Chemists' Association appeared before the Interstate Commerce Commission in the proceedings resulting from the railroads' application for increased rates. This association did not nor was it prepared to speak to this principle; that the chemical industry has a real interest therein, and will be affected by the Commission's varying treatment of these products, is apparent, and that it will be increasingly affected in the future seems beyond question.

An estimate of the consumption of heavy chemicals in the chemical engineering industries alone, about 1927, showed that of the total domestic consumption of about 25,300,000 tons, 15,800,000 tons was used by the chemical engineering industries. That this is but a part of our tonnage movement is evi-

dent. However, if we apply to this 15,800,000 tons the increases just authorized by the Commission, the amount of this increase for the year 1932 is $6,400,000. As this increase was estimated to be about 10 per cent, this means that the chemical engineering industry's freight bill on this part of its raw material tonnage is around $64,000,000 annually. At this rate, the freight bill on the entire 25,300,000 tons of heavy chemicals in domestic consumption annually is around $102,000,000, and this covers but a fractional part of the total tonnage of these industries.

Freight Rate Structure

The freight rate structure under which the railroads operate is not composed of isolated rates, differing radically at the caprice of the individual railroad. The individual railroad has little to say as to the rates it will establish, beyond suggestion to the group of railroads in the territory which it serves, and an endeavor to secure that group's majority approval. Even then, any interested individual may upset the basis by formal proceedings before the Interstate Commerce Commission, where final power lies.

Only actual orders of the Interstate Commerce Commission govern the rates made by the railroads, but the general principles indicated by that body in its many decisions form the yardstick for all rate making, and no one movement of freight can control its freight rate, unless it is properly related to other freight rates in the same territory. In turn, such territorial freight rates must bear some relationship to those in adjoining territories. Under the present and growing tendency in rate making, each rate bears a certain relationship to every other rate. It follows that once such a major adjustment is effective, it is very difficult to change any one rate within that structure; in other words, the structure tends to become "frozen."

Competition between individual railroads serving competitive industries formerly could be relied upon to make effective rates enabling its local shipper to get its raw materials or market its finished products on a workable basis. A group of railroads, whether in one great system or not, does not have the same competitive urge. The Interstate Commerce Commission is not charged with the duty to remedy any geographical or competitive disadvantage of an industry or locality. Under the law, rates must be non-prejudicial, must not be greater to a more distant point than to one intermediate thereto. These two great restrictions, within one of which is also the principle that large volume of movement does not deserve a lower rate than a single-car shipper, bring us to the basic governing rule of rate making of today: i.e., length of haul, or mileage.

To detail the gradual developments of the law which brought about this result would serve no purpose here. Throughout the various changes, however, it seems evident that the guiding influence did not come from the producing side of industry, which is directly interested in the cost of transporting raw materials. Rather was it the will of the distributing agencies of finished products, of jobbers, and of localities fighting to hold their geographical advantage as compared to some other town or city.

Seldom is a jobbing center concerned with the development of a product of nature. Out of such controversies came the application of one rule for all: mileage. Next came, logically, provision for a rate on every product, from every station to every other station. That the particular product moved only to one or more specific points had less and less effect; as a technical matter every station had to have its proper rate. To vary the rate between any two stations in one territory compels a change in the entire structure. A rate structure based upon the mileage relationship of one station with another, and designed to move merchandise and miscellaneous manufactured articles, will now fix the freight rates upon most raw materials of industry, and the production side of industry had very little to do with its making in any comprehensive manner. The chemical and process industries have here a common interest of great importance.

The New Classifications

Congress has directed the Interstate Commerce Commission that freight rates affecting agriculture must be held down to the lowest possible level and that, to insure this end, a survey be made of other commodities transported, in order that each pay its just share of the transportation burden. In the recent general decisions of the Commission, increases in rates on products of agriculture have been prohibited. Some thirteen investigations of the freight rates paid by products or groups of products as a whole have been made or are under way. Here, again, we have in process rate-making proceedings that affect the production side of whole industries. Their scope is such that individual issues become relatively insignificant.

The chemical and process industries have a real stake in these proceedings because their operations involve not only the initial movement of products of nature but many products are moved again and again as raw materials of a further processing. When they are products of nature, their location is fixed by nature, often far from a reasonable point of manufacture or from the logical market, in either of which cases the mileage yardstick of rate making is burdensome and often causes radical changes in costs of production.

Class rates govern all the miscellaneous articles of commerce which are shipped either in less-than-carloads or carloads. The carload movement of practically all the heavy-loading, comparatively low-grade, crude or partially processed raw materials of our industry has usually been made, heretofore, under commodity rates. Commodity rates are lower than class rates, and usually have been based upon a more specific consideration of the competitive factors surrounding a particular movement, as distinguished from the more general application of class rates. Under the passing competitive method of commodity rate making, a commodity rate usually bore no direct relation to the class rate.

Under these new class-rate schedules of Dec. 3, 1931, however, definite provision is made for the ultimate replacement, thereby, of all these commodity rates. As all rates therein are related to first class, which is 100 per cent, and as first class names the rate on such articles as boots and shoes, etc., it follows that the revised rates on, for example, salt, or acid, or soda ash, or anything else, may ultimately be revised to express a relationship to the rate on a case of shoes, although it is evident that the transportation service performed has no similarity.

Effect on Chemical Industry

As about 89 per cent of chemical engineering industries are located in Official Classification territory—i.e., east of the Mississippi River—it is evident that our industry has a great interest to protect in this current major revision of the base freight rates under which it has developed and must operate in the future. Details may be important to individual industries, but the industry as a whole has a broader common interest. The groundwork for this revision will be laid in the year 1932, and once done, will not be readily susceptible to change.

With this in mind, the chemical industry has a real reason for deciding for itself what share of the total freight bill its raw materials and products are paying and should equitably pay, and having decided, assert its views before the rate-making power. The arithmetic is simple: if the railroads needed $600,000,000 more annually, and agriculture and livestock with 12 per cent of the tons moved were to be exempt from increase, it meant that the other groups of products transported had to take up the slack, and the pro-rata distribution of this exempted amount among all others assumed important proportions.

A true understanding of this industry-wide question seems now to be of over-shadowing importance in any discussion of the transportation problem. Much has been accomplished by improved packaging and new vehicles of transportation. Motor trucks and water transportation will play their part anyhow; plant location will have its effect, but none of these will enable the industry to get along without efficient railroad service, and freight traffic will have to pay the bill.

Storage and Warehousing

As Factors in Economical Distribution

By J. D. COLLIER
Distribution Engineer, Chicago, Ill.

TIME was when chemical manufacturers required the chemical consumer to carry the burden of an excessive inventory, sometimes entirely out of proportion to his needs—a dubious advantage of the so-called sellers' market. For reasons that need not be discussed here, this is a condition which probably will not exist again in the near future.

In some instances plants or branches are lying idle; production costs have been hammered down to the lowest point that efficient machinery and methods have made possible. However, these costs have often been reduced by increasing production rather than by cutting costs on reasonable quantities. Consequently, volume is still the dominating factor.

Fortunately, many of the most difficult angles of this problem are absent when considering chemicals, for, generally speaking, few, if any, can be regarded as luxuries or semi-luxuries. Their consumption depends to a great extent on industrial requirements and the producing or manufacturing centers are largely localized by the special nature of the commodities.

With these established facts, provided that the proper operation, advertising, and sales efforts are made, there still exists a most vital factor to meet this new condition: namely, economical distribution. The late Prof. W. E. Butterbaugh, of the University of Minnesota, after an extensive study of the subject, stated that "distribution presents the greatest problem faced by the business world today" (as contra-distinguished from marketing) and it is the physical phases of distribution, shipping, transporting, handling and storage of material, the management and administration of these service charges and legal matters connected with them, that now offer the greatest opportunity for savings to American industries.

Choosing Distributing Media

Nor have conditions ever been more imperative or favorable than at present for the full consideration of the various factors comprising distribution. Production is low, plants are down, branches are closed and stocks are at the minimum. To sell a large volume in small individual sales, distribution must be so perfected that every possible saving can be made.

Editor's Note: The author's specialization on the physical aspects of distributing materials has given him particular occupation with warehouse problems and special consultation with the U. S. Department of Commerce on the transportation features of an economic survey.

You should realize that you are never any nearer your customer than are your goods. Acceptability of your merchandise is imperative, and in many instances more important to your customer than your advertising, sales effort or even price. Your customer has the right to do business on a reasonable inventory and to expect the replenishment of his stock with your commodity in a reasonable time at a reasonable price. You should make this possible by a proper distribution system consistent with the commodity, sales volume and distribution area. You should consider first, is your plant properly located? If so, what area or territory can it most economically serve? Are your branches properly located and are they serving the proper territory, considering area, sales volume and freight rates? Are you using to the fullest advantage all the available factors in distribution, such as motor trucks, boats, pool cars, public warehouses, railroads, intra-coastal boat lines and inland waterways?

These subjects comprise the distribution problem and can be properly handled only with the full and complete cooperation by the executives in charge of production, sales, advertising, traffic and transportation. An analysis should now be made regarding the advisability of continuing large production at a central plant or of establishing outlying manufacturing or assembly plants or carrying stocks at strategic centers to serve proper distribution areas. Perhaps shipping in bulk to a smaller plant should be considered. If so, where shall this plant be located, how shall it function and what area should it serve? The location must be carefully studied for service and freight rates, also its effects on competitors and competitive commodities.

In many instances, the services of a public warehouse is the most economical method of distribution; in fact, in the entrance of a market, it should be given first consideration. If sales conditions warrant, the first consideration should be the use of a pool car; that is, pooling a number of less-than-carload shipments to be made up into a carload minimum in order to obtain the carload rate. This car can contain shipments to be delivered at the destination or break-up point, or to be reshipped from there via motor truck, railroad or other transportation facilities to other points in the immediate territory.

The public warehouse or agency to whom this car is consigned will receive, deliver locally and reship the contents of the car, for which service a reasonable charge is made. Managers of public warehouses are familiar with local conditions, are fully responsible, and can protect both the consignor and consignee on claims of shortages, loss or damage to the goods.

If a larger sales volume exists, a spot stock should be kept at a reliable warehouse at the distribution center. Consideration should be given to the so-called "per package basis," under which there is a storage charge per package, per month, plus a handling charge, which includes unloading of the car, placing it in storage and shipping it out. The services offered by public warehouses are so numerous and varied that it would be impossible to describe the full scope of service available. They include assembling, marking, packing, making out of shipping papers, including bills of lading, and even accepting orders direct from customers and sending out shipping notices.

Further Warehouse Services

I have known warehouses to unload tank cars, fill drums for delivery to customers, collect the empties and even steam-clean them for re-use. Some keep open stocks of some commodities, filling miscellaneous orders, packing and shipping; in fact, acting in all capacities as an agent of the consignor, except that of selling. Each example, of course, is individual, but these illustrate the flexibility of the service and its possibilities as a factor in chemical distribution. Public warehouses often handle these activities much more efficiently than could be done by a district sales manager, and, in turn, relieve him of the responsibility of activities which are foreign to his training and ability.

When a market is firmly established in a territory, it then frequently becomes more economical to rent a certain area or space from the public warehouse, but this should not be done unless the volume is steady, and then only after a study of the space required and the cost of leasing. The value of the per-package basis is that it involves no fixed charges. The expense is commensurate with the amount of business done, but when a certain volume has been reached so as to justify a fixed expense, it is cheaper to rent a certain area.

Merchandising and Research

By R. G. CASWELL

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Boston, Mass.

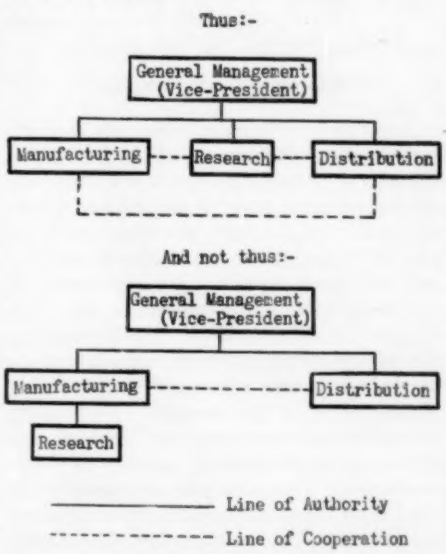
IN the good old days before industrial research became organized and possessed the threateningly competitive characteristics as a major factor of industrial progress which it now manifests, industries used to set up financial reserves for depreciation and obsolescence. These reserves, by and large, were entirely adequate for the safeguarding of capital employed in the investment. Today, the position of affairs is defined by the simple statement that persistent employment of industrial research constitutes the only reliable bulwark against the hazard of an almost total depreciation of investment.

It requires no lengthy citation of instances to convince that scarcely a twelve-month passes without the specter of product obsolescence passing over some industry. It is an admittedly long reach from the buggy whip to the accelerator pedal as an improved agent in travel, but a very short reach from the hook-and-eye to zipper fastener. And the present situation in the safety-razor industry furnishes some cogent lessons in this respect. In a perfectly general way, fear of product obsolescence through the results of substantive research has led manufacturers to regard their expenditures for research not only as in the furtherance of product and market betterment but also to protect life of the industry itself.

Inasmuch as product and process research, from the very nature of the activity, had its origin and development in the manufacturing phase of industry, it logically followed that much of the incentive, and most of the control, came to reside in the manufacturing function. This alignment might be an entirely correct one if research were concerned primarily with the probe for altogether new ways and means that would sweep all the past cleanly away. On the contrary, most research activities do not project revolutionary discoveries. They have for their object the effecting of step-by-step improvement in respect to performance, to appearance, and to versatility of the product in service.

In the light of these considerations, one important function in the planning and direction of industrial research is to anticipate buying trends and habits of, say, three to ten years hence, and provide for their supply. The problem is only in part limited by what should be done to safeguard production and lower costs, but from a broader and more extended point of view, research should visualize what the product should be at the end of a decade. In this view there is implied a relatively long-term forecast which carries with it the necessity for intimate knowledge of probable market and anticipated demands of the consumer.

It is axiomatic that the things most readily sold are those for which a natural demand exists and for which the demand does not have to be created and stimulated by an extended program of sales promotional effort. To this end it is our thought that the maximum effectual economic aid accruing to an industry through its research activities would be the more likely to obtain when the guidance of research is correlated with the arm of the industry intrusted with the marketing problem. By this it is not intended that research direction should be separated entirely from the manufacturing function, but merely that the factor of the division of control between manufacturing and merchandising in relation to research should be in balance, so that a chart of functions would read:



In not a few large corporations that maintain extensive research establishments, this modification has for some time been in effect, with the director of research exercising substantially the powers of a vice-president on a par with those in charge of manufacturing and of distribution. This gradual rise in the status of research is a recognition not only of the importance of research but also of the interdependence of this function and the distribution function.

An instance of the close relationship between product research and marketing in the bearing of these factors on the salability of the new product is furnished by the case of a prominent rubber manufacturer who developed a new hot-water bottle. In respect to appearance and durability in service it was without a peer in the trade. The product was producible, moreover, at an economic manufacturing cost with a highly satisfactory margin of estimated unit profit. The project was carried through the development stages, and sales were consummated to the extent of some ten thousand units. Sales resistance was then encountered. It was found to be impracticable for the company to market this product to druggists, the natural outlet, without a fairly complete line of druggists' rubber sundries, such as ice packs and gloves. The manufacturer decided against entering this field, and the experimental investment in time and capital was forthwith abandoned.

Looking to the future, a new market in which a natural demand exists, and which requires the highest degree of cooperation of the research and merchandising functions, is the fast growing demand for relief against the discomforts of summer travel by rail. Within the past summer this demand has been partially met by the installation by one of the Eastern roads of an air-conditioning system on one of its "crack" trains. The practicability of this project may be limited because of excessive operating costs. The field of development may be wide open. The factor of radiation through the steel walls of a Pullman is tremendous. It is a fact that certain ceramic materials, notably porcelains, manifest approximately one-fortieth of the rate of heat transfer of steel. The whiteness attainable in these porcelains is an additional factor in their favor as bad absorbers of heat. It is not inconceivable that commercial possibilities exist in the development of porcelain coatings to yield an adequate factor of insulation against the transfer of heat from without.

Whatever the technical difficulties in the development of process and product, research alone could hardly initiate and proceed with a project of such breadth without prior study of market and without constant guidance supplied by knowledge obtained through the distribution function.

It is our thought that research is nothing less than consciously stimulated evolution. But the essential point remains that, to be effective in the economic sense, product research must be guided by the study of market. When this condition is not observed, the stage is likely to be all set for throwing the whole project out of balance, with consequent loss in time and investment.

Does Market Research Pay?

By THOMAS C. GREGORY
Chemical Economist
New Dorp, N. Y.

LEADING economists predict that this country will enjoy its greatest expansion in industrial activity as soon as the change in the business cycle occurs. Forward-looking executives of strong, adequately financed companies now are not only devoting their energies toward maintaining their companies' current earning power but are preparing for the turn by carefully planning and laying the foundation for an increased share of future sales and markets.

Editor's Note: As former manager of the commercial development division of the American Agricultural Chemical Co., and as a consultant for a number of prominent organizations identified with the industry, Mr. Gregory has had an opportunity to observe the practical value of commercial research in various fields. The confidential character of these relations prevents him from disclosing the details of specific studies, but his observations of the results that can be obtained by properly constituted and directed market research are of interest and value to chemical engineers as well as chemical manufacturers.

Many executives of chemical companies have found market research of substantial assistance to them in these activities. It might be interesting, therefore, to consider some of the fact-finding and interpretive purposes to which executives have put market research. They may be divided into six sorts as follows:

1. Forecasting and interpreting effects of major trends in the chemical industry.
2. Forecasting future consumption in order to plan production schedules and future plant expansion.
3. New product surveys. These products may be already on the market but not now made by the department's employer. The research usually is divided into two studies, the first, a "high spot," the results of which determine whether the second, "an intensive" shall be made. It depicts the past and forecasts the probable future commercial history of the product. It tells the executive whether he should manufacture the product, and if so, how much business he may reasonably hope to secure over a term of years; where that business lies; and what the probable profits will be. Market research can furnish the executive with a knowledge of the product's markets, the individual consumer's purchases and requirements, and competitor's accounts.
4. Special sales problems. These are timely studies that may be of importance at the moment, such as:
   - (a) Checking trend of sales against competitors.
   - (b) Locating cause of declining sales in a given industry or territory.
   - (c) Investigating consuming industry's possible swing from one chemical to another due to lower price or other advantage of the latter.
   - (d) Studying consumer's special requirements to develop the optimum product for his process.
   - (e) Studying packaging (1) to cut costs, (2) to increase sales.
   - (f) Plant or warehouse location or relocation.
   - (g) Studies of distribution methods.
5. Examination of submitted projects. Every large company is constantly solicited to buy or invest in various projects. These may be mines, patented products, and special formulas. Propositions of this type are turned over to the market research department for investigation. Possibilities of mergers also come under this heading. The market research department must study the company and its products and report on its importance as a producer and distributor of these products and its possible merger value to the management.
6. Missionary work. This covers products which have never been on the market before. It comprises (1) locating industries to which the special chemical and physical properties of the product will be useful; (2) working with those industries to develop uses and methods of use.

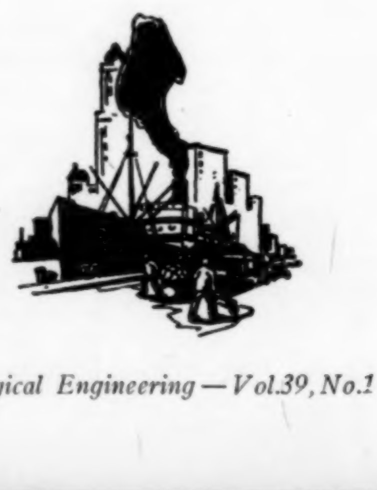
Essentials of Success

An efficient market research department must, therefore, be prepared to furnish a broad variety of service. Its personnel must possess uncommon qualifications. Chemical training and an ability to grasp the essentials of processes is important, but not every chemical engineer will be successful in this line of work. The commercial viewpoint, the vision of the sales executive, and an ability to gather facts and properly interpret them is paramount. Facts may be statistics, trends of one kind or another, or expression of opinion or preferences by an individual consumer. If the facts are contained in technical, commercial or government literature, then the researcher must know how to obtain them quickly. If the facts are in the hands of consumers or other persons, then the researcher must know how to obtain them by tactful interview.

Does this type of research pay? There is no doubt that it does, because it eliminates the elements of chance and uncertainty from the problem and provides real facts upon which to base decisions. This, of course, is a pure assertion and as such is open to dispute. Within the last few years the technical press has contained a number of articles advocating the value of market research. It has been the writer's opinion that such articles have all been weak in that they were purely assertive and did not offer any actual conclusive examples to support these assertions. This writer prepared, from his own experience, a set of specific examples for use in this article. Unfortunately, several unforeseen difficulties were encountered. When the examples were described in such a way as not to disclose confidential operations of companies they appeared too general to be convincing. On the other hand, when commodities and markets were actually mentioned by name anybody with an intimate knowledge of the chemical industry could quickly identify the companies concerned. This writer feels, therefore, that here is another article open to the same specific criticism.

The fact remains, however, that many prominent chemical companies *are* relying on market research to guide them along the general lines indicated above. Some of these companies are among our most successful chemical manufacturers.

What does market research cost? This question is difficult to answer. Sometimes the solution of the most perplexing problem can be arrived at with the expenditure of very little time and money. On the other hand, a department is often asked to conduct research which runs into considerable money. The acquisition of the information called for may involve a considerable outlay in time and travel, and these rapidly build up costs. Some executives seem to lose sight of this fact and are prone to specify their requirements without limiting the consumption of time, travel and other expenses. The result may be a brilliant piece of research work, quite successful from the artistic point of view, but too costly and of not sufficient importance to warrant the expense involved. Therefore, it is highly desirable that every propsed research be confined to the limits of a cost mutually agreed upon in advance of the study. Experience in this line of work will enable the director to form a pretty close estimate of what the work will actually cost.



Selling Chemicals Over the Counter

By G. A. PROCHAZKA, JR.
Consulting Chemical Economist
New York City

A NATIVE of New York in 1889, the author completed his education at Columbia University in 1913 and entered industry by way of the Central Dyestuffs & Chemical Co., Newark, N. J. Working as a chemical engineer he became so engrossed in the technical balance sheet that he **eventually published his ideas in the** book "Accounting and Cost Finding for the Chemical Industries," published in 1928. Later he was employed with the du Pont company and since entering a consulting practice has made a survey for the coal industry.

MOST of the goods made by the chemical manufacturer are sold in the industrial market. Intense competition and concentrated buying power make this a place where pennies count. The margins, as a rule, are pitifully small. A large volume of goods must be moved through the factory gates to keep the corporate balance sheet out of the red. It is a heart-breaking struggle.

When a man who has been working at fever heat to get the meager unit profits of the industrial market hears of the four-to-one spread ordinarily available between the factory warehouse and the retail counter, he immediately says, "Ah! there is the place for my goods." Is this really the place for his goods? Is the grass in these distant fields as green as it appears to be? Unfortunately, this is not a situation that can be disposed of by a simple statement. There is much that the chemical manufacturer should know about these markets before he tries to enter them. He may lose a fortune thereby, and again he may win one.

The first problem to be investigated is the question of having goods suited to this market. Has he a product which can be sold to the ultimate consumer? There are relatively few out-and-out chemicals which can be sold in a satisfactory volume to the householder. Consequently, entry into the consumer market may mean taking up some of the more highly developed chemical lines such as drugs, soaps, paints, insecticides, and the like.

Merit in Consumers' Markets

The producer must realize that he cannot hope to capture a place in the consumer market unless his goods possess intrinsic merit. This is a point that is hard to understand in its full significance. What seems a meritorious product to us may be of no interest whatever to the public in general. To be valuable for consumer merchandising, the item must possess merit in the opinion of a large number of people. What the opinion of a large number of people will be cannot always be predicted. Thus some goods are borderline cases. These require careful field tests.

We sometimes find a product, which we believe to have little merit, moving to the public in a surprising volume. We investigate and discover some curious things. The consumer attraction for these goods is largely psychological. The public likes the shape, the color, or the smell. Again, the size of the package may be unusually convenient or the trade name may have been cunningly selected. Sometimes people use goods in strange ways which are quite foreign to the original thoughts of the producer. A hair tonic or a mouth wash may have a large following who swear by these things as excellent beverages. Before the manufacturer is fully informed as to the underlying market appeal for his product he will have to search diligently over some very tricky mental paths.

There is an overlooked aspect of the consumer market that has brought many a man to grief. The American public is price-conscious. The cost of goods is judged in terms of the cost of other goods. An electric ice box or an oil burner is likely to be thought of in terms of Ford cars. The mere fact that these three things can all be classed as machinery is enough to get the lay mind working in an illogical way. It will be argued, you can get so much tin of this kind for $400, so you should be able to buy an equal quantity of tin in another form for the same amount of money. The manufacturer must accept the fact that the public's standards of comparison are not scientifically selected. He must adopt the line of least resistance and meet the situation as it exists, because a campaign of education is likely to ruin him financially.

Shrewd merchandising men immediately classify an article as a twenty-five cent, a dollar, a five-dollar, etc., seller. These merchants know that the public will not pay more than a certain amount for a given item, because they visualize the comparisons which will be made. Any man who would successfully enter the consumer market must do likewise. The man on the street has no interest in the intricacies of processing.

Merchandising Channels

Assuming that the chemical manufacturer has taken the preliminary hurdles successfully, how is he going to get the elusive public to buy his goods? There is the weak spot in the argument. Few understand how the gap is actually bridged. After the thing has been done there may be some doubt as to how it was done. A citation from a court record will serve to further illustrate this thought.

"Cream of Wheat" merely consists of selected wheat middlings such as are made by every flour mill in the United States. In the Great Atlantic & Pacific Tea Co. vs. Cream of Wheat Co., Judge Lacombe said, "Either because it [Cream of Wheat Co.] has used good judgment in its selection, or well advertised its trademark, it finds a ready market for its packages." Undoubtedly, even with so well a se-

lected trade name, a product such as this would not occupy its present prominent market position unless it had been properly advertised. This article can be used in every household, is easily prepared, and makes a palatable breakfast dish for young and old. Here is a product which has all the elements for successful consumer merchandising, and it has been merchandised successfully.

If package goods are to be sold in a satisfactory volume, consumer demand must be created. How is this urge to buy to be developed? It cannot be aroused through the retail storage; the manufacturer must employ other means to create consumer demand. He must go direct to the public in order to sell his package goods. The only medium open to him for mass action in creating consumer demand is advertising.

That the retailer cannot be used to create consumer demand readily becomes apparent when a few facts as to this type of business are examined. To make money a retailer must stimulate the flow of goods over his counter. Arguments take time and tend to cut down the flow of his goods. He, therefore, cannot afford to debate needlessly the merits of any one item. Usually he takes the line of least resistance and argues only when he believes he is going to lose a sale entirely and must argue to save the business. If you should want something in pink he gives it to you in pink. However, should it happen that most people are buying this item in green, and to meet the prevailing demand he carries only green ones in stock, then he will argue with you to take a green one. If the sale appears to be slipping he will offer to get you a pink one the following day. That the retailer stocks only what he thinks the public will buy and that this merchant argues only to move his existing stock should be accepted as an axiom by the manufacturer. If you have a normal case of consumer merchandising, do not try to create a demand for your product through the retailer.

There is another reason why it is difficult to sell unknown goods through retail channels. To meet the demands of a diversified trade the retailer must stock a large number of items. Most retailers are not in the least anxious to add to their inventories unless they are firmly convinced that the goods will sell. Possibly the prospect of a very long profit may induce them to take a chance, but if the chance does not work out you have made your last sale. When you try to find a place for your goods on the shelves of the retail store you will find these shelves pretty well littered up and the only way you can get the retailer to dust them off for you is by having a lot of people walk through his door asking for your goods. To meet the competition of other shelf stock you must be armed with consumer demand.

Advertising to create consumer demand is a fickle specialty. Some items lend themselves to advertising appeal better than others. The mere mention of body odor or bad breath will stampede people into buying when a carefully couched brochure to redecorate the old homestead falls onto deaf ears. Some articles can be tied up to a force which will make people buy goods, but with other items it seems impossible to present a situation which leads to mass purchases. In this sense advertising is fickle. There is always the possibility that goods which appear to be unmanageable from the advertising viewpoint can be treated effectively in a new light by some one.

Besides all this, consumer advertising is so costly that unless large sales result, the unit cost per article becomes prohibitive. We must remember that full-page space for one insertion, in a prominent newspaper with a wide circulation, may cost upward of a thousand dollars. The charge for a page in some of our weekly periodicals is more than several times this amount. As the advertising effort must be sustained to produce results, large sums of money are required for a consumer merchandising program. Of course, most of our well-advertised consumer goods were not brought out in one bold stroke, but gradually grew from small beginnings, the soundness of the merchandising methods being carefully tested all along the way.

Maintaining Resale Prices

After the chemical manufacturer has successfully mastered these underlying tasks he is confronted by other complicated situations. He must maintain the resale prices which he has established for his goods. Possibly few things have brought the producer of trademarked goods as much trouble as the effort to maintain resale prices. Considerable data on these complex situations are available in "Statutes and Decisions Pertaining to the Federal Trade Commission, 1914-1929" (Government Printing Office, Washington, D. C.).

To understand the problem of maintaining resale prices the manufacturer must appreciate the widespread use of a simple merchandising trick. If the merchant is to sell goods he must get buyers into the store. Consequently, with this point in mind the retailer offers bargains. These bargains are called leaders. Widely advertised goods, being well known, make attractive leaders to get people into the store. This practice, however, is not confined to the use of trademarked goods. In the grocery trade the common staples, such as butter, eggs, sugar, coffee, tea, etc., are widely used for this purpose. Advertised goods are used to lend variety to the act. If a manufacturer is running a heavy advertising campaign, some retailers are certain to hitch on to it, cutting prices below the standard resale value to stimulate their business on other goods.

When resale prices are not maintained the advantage of selling trademarked goods gradually disappears, because the market tends to concentrate in the cut-rate stores and they get into a position to dictate purchase prices to the manufacturer. Legal remedies have been proposed, but they have never materialized.

There is no intent to discourage the chemical manufacturer from entering the packaged-goods field. If he has goods that lend themselves to this work he should place them before the ultimate consumer. But the problem of securing distribution is not a simple one; it can be solved only if he recognizes that it is a problem and then goes about it in an open-minded manner. And the principles of consumer merchandising which have been discussed in this article need not be rigidly adhered to in all instances. When they are not followed, however, there must be a sound reason for the departure. Thus if an article has unusual properties it can be marketed at a much higher price than the consumer is accustomed to pay for similar goods.

Carbona is an example of a product which is being sold at a great advance over the ordinary cleaning fluids. There are definite reasons why 2½ fluid ounces of carbon tetrachloride can be retailed for 20c. when a gallon of gasoline can be bought for less than this amount. People find it convenient to clean clothes, yet the hazard of doing this has been brought home to them by many vivid newspaper accounts of serious accidents resulting from the careless handling of inflammable solvents. Apart from this, it must be remembered that the cleaning fluid field is a large one and that a producer need not capture a large percentage of the total business to move a substantial volume of goods. Prestone is another example of a product which is being marketed without paying strict attention to the consumer's standards of comparison. The market for radiator anti-freeze also is very large. Possibly another important factor is the great cost of repairing a motor which has been cracked by frost. The alcohols are cheap, but people feel most uncertain as to whether they have enough in their radiators to give them protection in freezing weather.

The producer who feels doubtful of entering the consumer market with a suitable product should recall that such trade names as Prestone, Pyrene, Carbona, Oakite, Sani-Flush, Drano, H. T. H., Zonite, Vaseline, Twenty-Mule Team, are but a few of the common words that some enterprising chemical manufacturers have added to the consumer's vocabulary.

Profits vs. Distribution

By O. FRED ROST

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O. FRED ROST writes from an experience of more than 25 years in marketing a wide variety of industrial products, raw materials and equipment. His contributions to the study of distribution in the field of electrical appliances has been recognized in several of the official prize awards of that industry. In addition to his services as marketing editor of *The Business Week*, Mr. Rost is director of distribution surveys for the McGraw-Hill Publishing Co. It is in the latter connection that, at the request of the editor of *Chem. & Met.*, he is now directing his attention to some of the basic distribution problems of the chemical and closely allied process industries.

CHEMICAL industry, in common with every other type or size of business enterprise, has as its ultimate goal the realization of profit as the just reward for effort expended. Up to within the last few years the road to profit for chemical manufacturers lay predominantly in all those activities that are directly or indirectly concerned with production. Waiting markets were ready to absorb most or all the output that production departments with their steadily increasing efficiency could furnish, and manufacturing executives struggled chiefly with the problem "how much can we make" rather than the question of "how much can we sell—at a profit."

In common with every other important industry, various branches of the chemical industry have during the last decade successively reached that peak of expansive development where the supply began to exceed the demand. Overcapacity has become evident in more intensive competition for available business, and in some fields destructive price wars have resulted in a condition of profitless selling which can be ended only if a determined effort is made by individual manufacturers to hold their production to such volume as they can properly distribute at a profit. To do this the manufacturer must necessarily know how, where, when, by whom, and to whom his products are distributed. In other words, he must have recognized distribution as a problem separate and distinct from any other, and must have accumulated definite knowledge in its relation to his particular business.

Up to recently there has been little or no conscious recognition of the fact that problems of distribution may actually exist in the chemical and allied industries and that frequently the degree of efficiency effected in the distributive functions directly determines the percentage of net profit. Practices prevailing in the distribution of the industry's products have been taken for granted, and the channels, processes and functions involved in distribution have rarely if ever been segregated or analyzed.

In present-day usage the term distribution has found several different interpretations. In its narrowest sense it is applied only to the process of physical transportation of a commodity from the point where it represents the finished product of one manufacturer to the place where in that form it enters use or meets consumption. In the chemical industry an example of distribution in its simplest form would be that of a manufacturer who "produces" CO_2 as a byproduct and "distributes" it through a pipe line to another manufacturer across the street who there solidifies it for refrigerating purposes. In that instance, all the functions of distribution, taken in its narrowest sense, are practically performed with the turn of a valve.

In every business transaction that involves a tangible product the physical transportation of the goods is only one phase of such transaction. Either preceding or following the actual physical conveyance of goods it requires a multiplicity of other equally indispensable functions and procedures, which have a direct and inseparable influence upon the ultimate benefits that accrue to seller and buyer. Because of this fact the broader interpretation of the term distribution includes all those contributory factors, functions and procedures. In connection with the product itself it includes the size and type of container, if any; the manner of packing; the marking or labeling; the routing, handling, loading, shipping and final delivery to the point of use.

Distribution also includes advertising and sales promotion, pricing, actual selling, sales office routines, credits, invoicing, accounting and other supplementary activities which occur until final payment for the goods closes the transaction. The cost of all these functions properly constitutes the cost of distribution of a product. In the chemical industry undoubtedly these costs vary greatly by reason of different characteristics of the product, variations in the place and manner in which the product is used, and differences in the channels through which it actually or theoretically travels before it meets final use.

While but little authentic information on distribution costs is at present available, the editors of *Chem. & Met.* have collected some figures published elsewhere, which effectively demonstrate the considerable difference that may properly occur in the cost of distributing different types of chemical products by their respective manufacturers. Such variations as are evident in these instances will be found to prevail to a greater or lesser degree throughout the chemical industry.

It may be taken for granted that during the present period, manufacturers in overcapacitated industries have exerted every influence to maintain profitable operation. It is probable that the greater part of their effort has been exerted in the direction of lowering pro-

duction costs so as to be in better position to meet the constantly declining price levels.

There are entirely too few instances on record where a manufacturer in the chemical or allied industries has definitely attacked the problem of his particular distribution for the purpose of finding in that branch of his activity the opportunities for economies, increased efficiency, more effective sales and marketing programs which must eventually produce more satisfactory profits.

It is safe to assume that the actual consumption of the various products of the chemical and allied industries will for some time proceed at a level that is below the industry's capacity to produce. It follows that if manufacturers merely compete blindly for all the business they can corral, they collectively will sustain losses while their customers will gain. Research is substantially the foundation upon which the chemical and allied industries have been built, and obviously it is through research that they must nurture and maintain their markets.

Every procedure and function involved in the distribution of a product is susceptible to systematic study that will undoubtedly lead to improvement of methods and greater economy or both. The actual cost of distribution is materially affected by the channels through which a product is sold and by which it reaches the point of use. These are in many cases determined less by the efficiency or economy with which they function and more so by the prevailing habits or traditions.

If the most economical yet most effective channel of distribution for a product is to be selected regardless of prevailing policies and traditions, available channels must be known and certain other factors definitely determined. According to the 1929 Census of Distribution process industry manufacturers distributed 87.7 per cent of their total products, valued at $9,786,000,000, through three major channels: through manufacturers' own branches, at wholesale, 30.1 per cent; through wholesale dealers, 30.8 per cent; direct to industrial consumers, 26.8 per cent; total, 87.7.

Where a product is of the type which as the finished product of one manufacturer travels in that form in large quantity or bulk to another manufacturer, only to become a part of his product or be absorbed in his manufacturing processes, the distribution problem of the first manufacturer is not necessarily complicated. When a product passes actually or theoretically through several hands, changes ownership—as, for instance, when a wholesaler buys it in large quantities and resells in smaller quantities—such complication is bound to result in rising distribution costs.

Distribution of most products is effected by a manufacturer in one of two ways. Under the "direct" selling plan the marketing, selling, packing and shipping to the consumer is accomplished by the manufacturer without the aid of any intermediary that is not acting wholly under the control or direction of the manufacturer. When a product is susceptible to this plan of distribution, its manufacturer is in preferred position to maintain operation on a profitable basis. Where the indirect plan of distribution is used, the necessary employment of agents, distributors, wholesalers, jobbers, commission men, results to a greater or lesser degree in complicating the process, may result in increasing its cost, and sometimes obstructs the free flow of the product. There are, however, hundreds of products which find their most economical distribution through those seemingly dispensable channels.

Factors to Be Considered

To discover the most suitable channel for distribution of a product three major factors must be determined with the greatest possible degree of accuracy. These factors are:

1. The various uses of the product.
2. The market for the product and economic marketing areas.
3. The existence and comparative effectiveness of distributing agencies in various marketing areas.

The Product—In connection with a study of the product, the existing opportunities for its use must be thoroughly understood; and the manner, method and effect of its use must be clearly charted.

The Market—The determination of markets for a given product involves the consideration of numerous basic factors if distribution is to be effected in the least wasteful, most efficient manner.

Through the published reports of the 1929 Census of Manufactures, manufacturers are enabled to know the approximate total production capacity of their particular industry, at least where major groups of products are concerned, and through the 1929 Census of Distribution they are enabled to trace the flow of those major groups of products through the various channels to the user. Every manufacturer has or should have a fairly accurate knowledge of how much of the country's total production capacity of any particular commodity he represents.

By the proper use of available statistics it is possible to determine the areas of concentration which absorb important quantities of a given product and the approximate quantities involved. A study would also disclose the volume and type of competition experienced in those important marketing areas.

The location, size, degree of aggressiveness, credit policy and financial status of competitors must be determined. By proper consideration of these major and other related factors a manufacturer should not only be able to determine the outstanding favorable and unfavorable characteristics of his market and its various constituent areas but the process should quite properly bring into focus those areas where a particular manufacturer can most economically and most effectively concentrate sales effort in order to obtain his proportionate share of available sales volume on any one commodity, at the lowest possible cost, with the least waste of effort.

Available Distributing Agencies

It has been pointed out that competitive conditions in many fields are very unsatisfactory, and because of this the prices on some products have been forced not only down to cost but in some instances below actual sound cost of production. With production costs in many instances already brought down to the irreducible minimum, manufacturers must necessarily seek further economies in the field of their distribution. Therefore, the usefulness of present or prospective distributing agencies must be considered from the standpoint of effectiveness and economy. Duplications of effort and unnecessary or dispensable steps must be avoided.

Where a manufacturer maintains his own distributing organization its efficiency should be measured by the amount of extra profit that is earned through its functioning, and unless unusual characteristics of the product or market are involved, that organization should be maintained only so long as it functions as effectively and produces greater reward. Frequently an independent agency, which spreads its operating costs over a number of related but non-competitive lines, can and does provide for a manufacturer better distribution at less cost. Also there are many products that should be distributed entirely through wholesalers, because with proper cooperation from the manufacturer the wholesaler can and does provide efficient distribution at low cost for certain types of products.

If a policy of direct selling is to be maintained with profit, the important factors already enumerated are particularly indispensable. A manufacturer must know with more than ordinary accuracy how, where, when and by whom his products are used; who his potential customers are, where they are located, what their financial standing is and what their buying habits are.

Direct selling, to be profitable, must be all that the name implies. Advertising must be placed where it most directly reaches the largest number of potential customers. Salesmen must concentrate directly on concerns known to be prospective buyers, and directly on the individuals that are known to have authority to buy. Improper or insufficient knowledge of the rigid essentials to successful direct selling results

in wasted effort, time, labor and expense and often causes serious loss of profit.

A special survey, recently made, clearly demonstrates to what extent problems of distribution are commanding the attention of important executives in the process industries. The president of one large company manufacturing heavy chemicals states: *"We believe distribution problems are to receive the attention of management in the next few years to a greater extent than they have in the past.* During the past two years we have given emphasis to the importance of technical information in the sale of chemicals. A few years ago we established a *technical sales service* which has worked eminently satisfactorily in its aid to sales. We have reduced expenses by a decrease in personnel, eliminating unproductive employees. We have a *committee working on packages;* also a *development department* working *on new products* and *new uses of the present products.* We have *concentrated* on the *most profitable lines of product* and have revised our selling organization to meet the present situation."

The executive vice-president of an important manufacturer writes us: "Answering your esteemed letter of the 29th, beg to state that within the past eight months our company has changed its merchandising policy, with a view of doing its business more directly with the consumer. Naturally, after a departure of this kind from a somewhat different policy that has been in existence for forty years, we cannot state at present whether our new program will prove less expensive than the old."

Here are some significant statements by a manufacturer who produces chemicals in connection with another process industry: "The principal change in our method of marketing our chemical products has been that in general we *have done less and less business through dealers and have come in direct contact with the consumers* . . . The direct method of selling has not affected our costs of distribution to any extent, because the *buyer usually gets the benefit of such economies* . . . With regard to prospective changes in methods of distribution, I think that both production and distribution of chemicals will require an increased refinement in the *technical training* of all those engaged in the industry . . . I feel that the *biggest problem in the chemical industry is connected with the distribution rather than with production."*

An important sulphuric acid producer states: "Referring to the three questions asked by you, the company has been giving merchandising policies a great deal of thought and consideration, especially recently, in order to cope with the changed conditions in the agricultural field. The start was made in greatly reduced selling costs and trying to bring down overhead costs somewhat commensurate with the reduction in business. *The principal effort will be to value a salesman's work on the profit that he makes for the company* rather than on the tonnage that he sells, as has heretofore been the case."

A large producer of organic chemicals thinks that mergers are needed: "If consolidation continues, a still larger percentage of the chemical business will be handled by a relatively small number of very large companies, *which obviously means less duplication of selling effort, and consequently, better efficiency, including lower costs.* It is our belief that further consolidation should occur, because a great many items in the chemical field have only a small market; and when several companies produce these small items, both the production cost and the distribution costs are very high and inefficient."

Truck Deliveries to Increase

The president of a leading fertilizer plant says motor trucks will be used increasingly. "I do not foresee any especially new methods of fertilizer distribution within the next two or three years, *except that an increasing portion of the shipments will be delivered by truck from factory or warehouse to the farmer.* This trucking situation is the most fundamental change in our industry."

Another large producer of raw materials favors water transportation. "It is possible that greater use of the waterways may be expected over the next two or three years, *which will have the effect of reducing transportation costs.* In many respects, this will be an unfortunate development for the rail-, roads, for many chemical raw materials load heavy and there are practically no claims for loss in transit."

A well-known manufacturer of pharmaceutical products writes: "I don't believe it would be possible to outline definitely what changes we have made in our merchandising policies and methods in the last two years; there have been so many and they have come so fast. The only thing I can tell you is that our method is entirely different from what it was two years ago and we are getting along rather well. Our methods have reduced our selling costs considerably. *We realize that the problem of marketing and distribution is an important factor in business today,* and we feel that in the chemical and pharmaceutical industry it is going in the wrong direction. There is a tendency for manufacturers to disregard their costs and either to give away merchandise without a profit and without considering overhead, or to distribute free goods, which is most detrimental, for *when merchandise is given away it simply means that so much more has to be sold before an ultimate increase in sales with corresponding profits can be looked for."*

This large pharmaceutical manufacturer knows something about distribution: "Our policy of distribution contemplates the sale of our products through the wholesale druggists of the country, and despite considerable pressure from different angles, this policy is today in effect. As to the effect upon our cost of sales, it is hard to say if adherence to our present policies has affected reduction in costs in the face of very keen competition in the trade and the policy of direct selling in some instances, as well as the appearance in the market of new and smaller manufacturers concentrating their energies on the production and sale of one or a small number of fine chemicals."

"Methods of distribution in the fine chemical industry, particularly that part of it that has to do with sales through the wholesaler and retailer, are, as you know, undergoing very rapid changes. We have seen the pendulum swing from wholesaler distribution to chains and direct selling, and *it would not be surprising if the trend should develop back toward the wholesaler again.* This statement is made only in view of the fact that this industry deals with a very large number of commodities, many of which are used in small quantities and infrequently, and yet, when they are required, the need of them is urgent. It would appear that the adoption of a general policy of retailer purchasing from manufacturers would probably throw the retailer into a very uneconomical method of obtaining requirements, necessitating frequent small ordering from a large number of manufacturers of proprietary products.

One of the largest manufacturers of heavy chemicals has been engaged in reorganizing his whole distribution system. Only a few of his significant statements can be quoted: "Generally speaking, the changes in our merchandising policies in the past two years have been divided into two parts: first, a reorganization of the direction of the sales work in the main office; second, a coordination of the activities of the field men in the various territories in which we operate . . . We are sure that the net result will be a substantial reduction in our selling cost . . . As to further changes in distribution in chemical industries, I have some very definite ideas. I believe that the coordination of selling activities of various large units will continue for some period of time. I believe that we will have more and more of the general type of salesmen handling a somewhat limited territory. In addition to these men there will always be, in our business, a number of technical men who will serve a much larger territory rendering special or technical service. The result, of the general salesmen having a smaller territory, *will be more intensive selling and more frequent calls.* They will know their customers and prospects better and be able to meet their requirements more intelligently."

Price Wars Cut Alkali Profits

EDITORIAL STAFF REPORT

FROM THE VIEWPOINT of the alkali producer, price wars probably were the outstanding business fact of 1931. And, very unfortunately for the industry, the only result was to present alkali users with a gift variously estimated at from something more to something less than $10,000,000. It is extremely doubtful whether the reductions sold a single pound more soda or caustic than would have been shipped had prices held, and from this standpoint the year was highly unsatisfactory. So far as production was concerned, however, alkali producers fared better than industry in general. Where, according to the *Business Week's* averaged weekly index of business activity, general business declined about 17 per cent from 1930 to 1931, and fully 30 per cent from 1929 to 1931, ammonia-soda production declined an estimated 9.8 per cent in the first year and 20 per cent in the two-year period.

Estimated Distribution of Caustic Soda In the United States

Consuming Industries	1929 Short Tons (Revised)	1930 Short Tons (Revised)	1931 Short Tons
Soap	108,000	100,000	95,000
Chemicals	135,000	100,000	90,000
Petroleum refining	134,000	117,000	100,000
Rayon	111,000	110,000	110,000
Lye	25,000	22,000	18,000
Exports	60,000	63,000	66,000
Textiles	42,000	30,000	32,000
Rubber reclaiming	40,000	20,000	14,000
Vegetable oils	11,000	10,000	8,500
Pulp and paper	45,000	42,000	36,500
Miscellaneous	48,000	38,000	34,000
Totals	759,000	652,000	604,000

The alkali industry would have been better prepared to meet the depression if, in the optimism of 1929, it had not added materially to its productive capacity. Some of this new construction was not completed until 1931 and it is doubtful if it has ever been run. At the start of 1931 the total annual capacity of the six ammonia-soda plants in operation was slightly more than 2,900,000 tons of soda ash equivalent. The capacity of the three natural soda plants in operation added some 90,000 tons, giving a total annual capacity for the industry of about 3,000,000 tons of soda ash equivalent. Not all of this is modern, however, and it is likely that not more that about 2,750,000 tons represents capacity that is available for regular production.

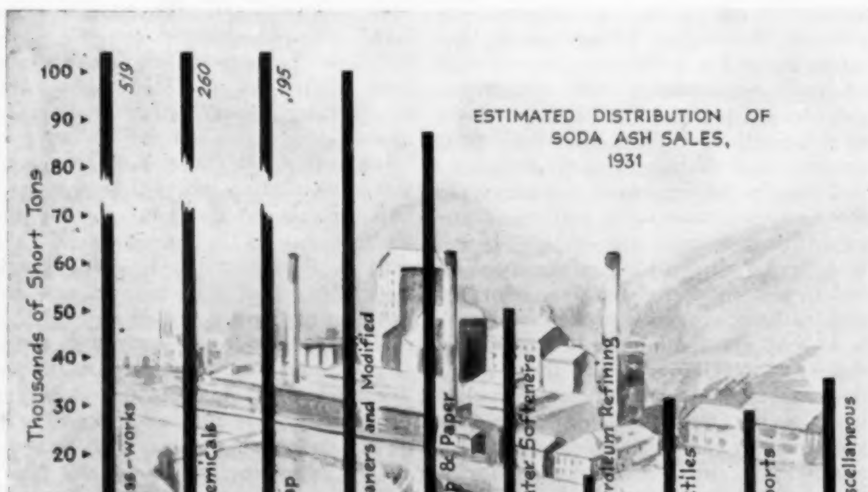
Against this usable capacity of 2,750,000 tons, 1931 saw an estimated equivalent soda ash production of about 2,024,000 tons, which is 73.6 per cent of capacity. This compares with a 1930 production rate of about 81.5 per cent of present capacity, while it represents an output about 90.2 per cent of that of 1930 and about 80 per cent of 1929. One of the tabulations on this page shows the estimated distribution of soda ash sales for 1929, 1930 and 1931. Sales represent the largest outlet for soda ash as such, and generally account for 60 to 70 per cent of the production. It will be observed that the decline for total sales was 10.14 per cent from 1930 and 20.5 per cent from 1929. Only the textile industry consumed more soda ash in 1931 than in 1930, registering an estimated 3.33 per cent increase. Other uses declined as follows: export, 22.2 per cent; pulp and paper, 13.0 per cent; miscellaneous uses, 12.5 per cent; glass, 12.03 per cent; chemicals, 10.35 per cent; water softeners, 9.09 per cent; cleansers and modified sodas, 8.93 per cent; petroleum, 6.25 per cent; and soap, 2.5 per cent.

Estimated Distribution of Soda Ash Sales In the United States

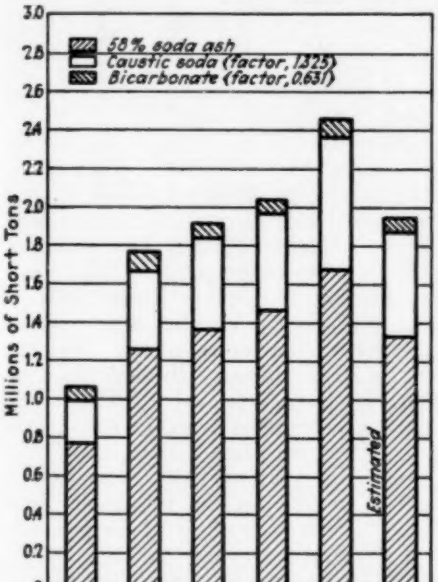
Consuming Industries	1929 Short Tons (Revised)	1930 Short Tons (Revised)	1931 Short Tons
Glass works	672,000	590,000	519,000
Soap	213,000	200,000	195,000
Chemicals	335,000	290,000	260,000
Cleansers and modified	125,000	112,000	100,000
Pulp and paper	110,000	100,000	87,000
Water softeners	60,000	55,000	50,000
Petroleum refining	18,000	16,000	15,000
Textiles	40,000	30,000	31,000
Exports	40,000	36,000	28,000
Miscellaneous	47,000	40,000	35,000
Totals	1,660,000	1,469,000	1,320,000

Caustic Consumption Cut

Caustic soda production encountered similar declines. Its estimated distribution by uses also is tabulated on this page. The total use of 604,000 tons decreased 7.3 per cent below 1930 and 20.1 per cent below 1929. Textiles and exports showed increases of 6.67 and 4.76 per cent, respectively, and rayon no change. This is accounted for by the fact that the increase in rayon production that is believed to have occurred in 1931 was only partly an increase in viscose yarns. Also it is now probable that part of the caustic used is being recovered



in American viscose plants, as it is abroad. In all other caustic-using fields, consumption declined rather heavily, ranging from a decrease of 30 per cent in rubber reclamation, 18.17 per cent in lye manufacture, 15 per cent in vegetable oils, 14.53 per cent in petroleum refining, 13.1 per cent in pulp and paper, 10.52 per cent in miscellaneous uses, and 10 per cent in chemicals to 5 per cent in soap manufacture.



Production for Sale of Principal Ammonia-Soda Products in the United States (Basis, 58 Per Cent Soda Ash)

Both technically and financially the greater part of the alkali industry appears to be in good shape. This is particularly true of the ammonia-soda producers, all of whose plants have been thoroughly modernized in recent years. These plants all effected equipment improvements, such as the substitution of larger carbonating towers of higher unit throughput capacity and the installation of larger distillation apparatus. The Solvay Process Co. is reported to have installed decomposers for converting the crude bicarbonate in solution directly to the carbonate. This supplies the caustic soda and refined bicarbonate departments. This company also has developed equipment of higher efficiency than that formerly used for the dehydration of calcium chloride. As is the case with most of the other producers, Solvay has recently developed further raw material supplies. Its caustic soda capacity likewise has been increased.

Two other producers have also enlarged or rebuilt their caustic soda plants and a third has such a program projected. Mathieson Alkali Works, with a plant at Saltville, Va., engaged largely in supplying Southern industries, has developed new quarry and waste disposal facilities and a new water supply. Columbia Chemical Co. and Diamond Alkali Co., both of which are associated with glass interests, and the former with soap interests as well, have enlarged capacity in recent years and improved their raw-material resources. Columbia, with American Cyanamid Co., is a part owner of the recently organized Southern Alkali Co., which proposes to build a large ammonia-soda plant at Corpus Christi, Tex.

Production of Caustic Soda in the United States

Year*	Lime-Soda (Short Tons)	Electrolytic (Short Tons)	Total (Short Tons)
1921	163,044	75,547	238,591
1923	314,195	122,424	436,619
1925	355,783	141,478	497,261
1927	387,235	186,182	573,417
1929	524,985	233,815	758,800
1930 (revised)	452,000	200,000	652,000
1931 (estimated)	422,000	182,000	604,000

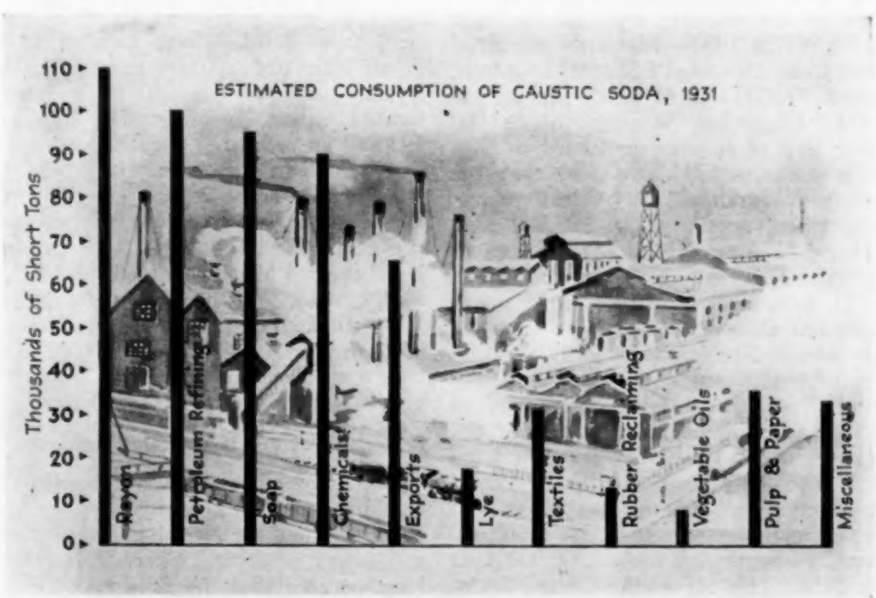
*Figures for 1921-1929 are from the U. S. Bureau of the Census. Electrolytic caustic soda figures do not include that made and consumed at wood-pulp mills, estimated at about 30,000 tons in 1927 and 1929, at about 28,000 tons in 1930, and 24,000 tons in 1931.

Michigan Alkali Co., next to Solvay the largest ammonia-soda producer, has partially completed an extensive development program. The company's two soda ash plants are being consolidated at the original location of one of the plants and the second plant will eventually be abandoned. Through connection with a number of associated enterprises, Michigan Alkali is especially well placed as regards raw materials. An affiliated cement mill and sales of limestone to steel mills help to carry its quarry costs. A coke plant located near by and controlled by the same interests sells coke and gas to surrounding communities and provides the soda ash plant with ammonia and coke at a figure substantially below what would otherwise be possible. The cement plant, in addition to assisting in the matter of raw-material supply, is also a valuable adjunct in that it provides an outlet for at least a part of the calcium carbonate sludge from the causticizing plant.

Position of Natural Soda

Natural soda plants are able to supply their own immediate markets but they cannot compete outside the West Coast region. In general they are small, with a total capacity now in operation only about $3\frac{1}{4}$ per cent of that of the ammonia-soda plants. The smallest of the three still in existence has produced quite constantly. The second lost a considerable export market and has since halved its production. The third and largest has for some time been in the hands of receivers but is now supposed to be on a paying basis.

Information on the costs of natural soda production is not available. So far as ammonia-soda plants are concerned, it is believed that the costs given on page 3 of this issue are well representative of the industry. Through the technical improvements of recent years, costs for the smallest producer are not far above those of the largest, although, on account of the manufacturing economies that are inherent in greater production, it is believed that the largest is able to show a somewhat lower production percentage than that given, which is about the average for the industry.



Borax Capacity Up

ADDITIONS to plant capacity made by the American Potash & Chemical Corp. during 1930 and 1931 added at least 75 tons per day to the borax capacity of the Pacific Coast. It is not known whether increased capacity was added by the three other principal producers. Although production figures are not yet available, the export rate would suggest that production has not changed greatly from the 1929 figure of 184,500,000 lb. Based on 11 months' record, exports appear to have totaled about 170,000,000 lb., compared with the 1930 figure of 165,862,630 lb. and slightly under 160,000,000 lb. in 1929.

Sulphuric Acid in 1931

EDITORIAL STAFF REPORT

SULPHURIC ACID production fought a hard and relatively unsuccessful battle against depression during 1931. Some few consuming industries made remarkably good showings, but they were able to make but little impression on the very large drop in consumption of acid for fertilizers. As will appear from an examination of the tabulation at the right, fertilizer consumption of sulphuric acid is estimated to have fallen 44.3 per cent from the 1930 level and 43 per cent from 1929. Fertilizers are still an occasionally dispensable item in the budget of the average farmer, a fact that is in large part responsible for an acid production of 5,562,000 tons, which is the smallest since the 4,000,000-ton year of 1922.

As a result of the fertilizer situation and other factors, *Chem. & Met.'s* estimates show that total sulphuric acid consumption declined 27.5 per cent from 1930 and 33.2 per cent from the record year of 1929. However, it should not be inferred that all acid consuming industries declined violently. It will be evident from the tabulation that the decrease varied widely with the consumer. Textiles, for example, enjoyed a better year than in 1930. This is the only consuming field that showed an increase, and the improvement was small, 3.8 per cent. Due to a rather sharp decline in acid use in textiles in 1930, consumption in 1931, despite the improvement, was about 10 per cent below 1929.

Estimated Distribution of Sulphuric Acid Consumed in the United States
(Basis 50° Be)

Consuming Industries	1929 Short Tons	1930 Short Tons (Revised)	1931 Short Tons
Fertilizers	2,418,000	2,477,000	1,380,000
Petroleum refining	1,570,000	1,420,000	1,220,000
Chemicals	890,000	820,000	760,000
Coal products	935,000	800,000	550,000
Iron and steel	800,000	660,000	480,000
Other metallurgical	675,000	560,000	410,000
Paints and pigments	225,000	200,000	180,000
Explosives	195,000	177,000	175,000
Rayon	150,000	145,000	145,000
Textiles	90,000	78,000	81,000
Miscellaneous	390,000	330,000	181,000
Totals	8,338,000	7,667,000	5,562,000

Acid in Consuming Industries

Except for rayon, which either remained at the 1930 level or may possibly have increased by an amount up to 10 per cent (in which case later revision may bring the acid figure to about 159,000 tons), every other consuming industry suffered a loss. Fertilizers, as was noted above, led the decline with a drop from 1930 of 44.3 per cent, and from 1929 of 43 per cent. Other decreases below 1930 were: miscellaneous uses, 45.1 per cent; coal products (principally sulphate of ammonia, the demand for which suffered with fertilizers), 31.2 per cent; iron and steel, 27.2 per cent; other metallurgical uses, 26.9 per cent; petroleum refining, 14.1 per cent; paints and pigments, 10 per cent; chemicals, 7.3 per cent; and explosives, 1.2 per cent.

The decreased use of sulphuric acid in petroleum refining in 1931 was entirely out of line with the drop in run to stills, which fell only 6 per cent. This clearly indicates that some considerable change in refining practice must have occurred. The most probable explanation offered is the greatly increased demand during 1931 for substandard gasolines in which less sulphuric acid is used than is needed in producing a water-white product. This was particularly true in the Middle West, where much off-color, underrefined gasoline appeared on the low-priced market, its color disguised by means of a dye.

This lessened acid production was, of course, accompanied by a corresponding decline in acid raw materials. Although sulphur mining was comparatively heavy—about 2,125,000 long tons, as against the officially reported figure of 2,558,981 in 1930—shipments amounted only to an estimated 1,350,000 long tons, about 400,000 tons of which was for export. Deducting the estimated 443,000 long tons of sulphur consumed in non-acid uses in 1931, we find that the sulphur purchased by acid plants amounted to only about 507,000 long tons, as compared with 851,605 tons in 1930. This sulphur accounted for a 1931 brimstone acid production estimated at about 2,755,000 short tons, expressed as 50 deg. Bé. acid.

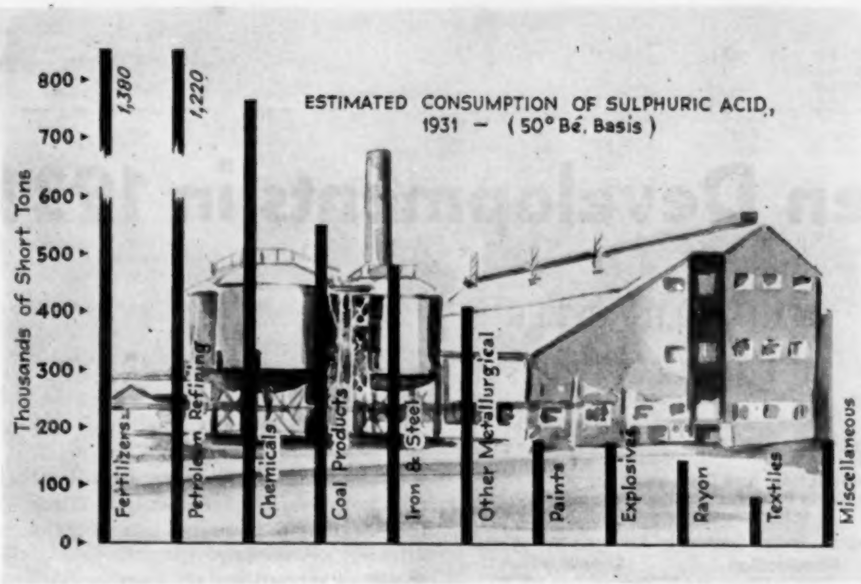
Sulphur exports declined 32.5 per cent from the 593,312 long tons of 1930; and shipments to domestic consumers of all kinds, 3.3 per cent from 1,396,605 long tons in 1930. World production of sulphur is believed to have totaled approximately 2,500,000 tons, as compared with 2,900,000 tons in 1930. This leaves the United States with a sulphur production about 85 per cent of the world total.

Increase in the Texas production tax on sulphur in October, which raised the rate from $0.50 to $0.75 per ton, was the factor responsible for the high level of sulphur mining activity during the first three-quarters of the year. Production dropped very materially at the end of nine months, with the imposition of the increased tax. For the period from January through September, production totaled 1,797,655 long tons, as compared with 1,880,862 tons for the same period in the record year of 1930. The rate of mining for the remaining three months dropped to 55 per cent of the previous average for the year and it is probably the intention of the producers to subsist very largely on stocks for some time to come, until the added tax, considered by the producers to be unfair, has been rescinded or otherwise made more acceptable. Stocks above ground in the hands of the producers at the turn of the year totaled close to 3,272,000 long tons, an increase of 775,000 tons over the inventory of 2,497,000 tons officially reported at the end of 1930. At the shipping rate of 1929, 2,437,238 tons, the quantity now above ground would care for all requirements for a year and four months without further mining.

Domestic production of pyrites appears to have decreased about 20 per cent, from 350,177 long tons in 1930 to an estimated 280,000 tons in 1931. Pyrites imports fell off to a much smaller extent, from 368,114 tons in 1930 to an estimated 365,000 long tons in 1931. With domestic pyrites containing on the average 36 per cent of available sulphur, and foreign pyrites, 48 per cent, acid production from pyrites is believed to have accounted for 1,507,000 short tons on the 50 deg. Bé. basis. It is estimated that the world production of pyrites in 1931 was about 6,200,000 long tons, as compared with a 1930 output of approximately 7,000,000 tons.

Survey of Byproduct Acid

The only other important source of sulphuric acid is that made as a byproduct from the waste gases of zinc and copper smelting. *Chem & Met.* has long realized that the only reliable in-



dices to this production were the figures given by the U. S. bureaus of the Census and of Mines, but these are available only one to two years after the fact. Accordingly, in the past year *Chem. & Met.* undertook a survey of acid from this source, with the result that a considerably larger production was uncovered than was previously believed to exist.

In all, 20 companies, operating 26 plants, are known to be making byproduct acid. These were all questioned in regard to the source and character of their gases, the type and capacity of their plants, and their normal and 1931 acid production. Data were obtained from 13 of the companies, representing about 44 per cent of the total installed byproduct acid capacity of the United States. These companies have a total capacity in terms of 50 deg. acid of about 940,000 short tons. The seven concerns which would not supply their figures have a total capacity of 1,195,000 tons (50 deg.), according to estimates believed to be reliable. It is therefore evident that the total byproduct acid capacity of the United States must be in the neighborhood of 2,135,000 tons of equivalent 50 deg. acid. A small part of this capacity, however—perhaps 50,000 to 100,000 tons—is operated on brimstone gas used in the same plant to eke out or stabilize the smelter gas supply.

Those concerns which reported showed an estimated 1931 production of about 570,000 tons of equivalent 50 deg. acid, which represents 60.6 per cent of their capacity and about 82 per cent of the normal production of these plants. Applying this percentage of capacity, weighted to take care of probable conditions in three very large plants, to the capacity of the plants not reporting, we reach an estimate of about 781,000 tons of acid for the unreported balance, and for the total of the byproduct industry, deducting for acid made from incidental brimstone, about 1,300,000 tons of equivalent 50 deg. acid in the past year. This represents a decrease of about 9.7 per cent from the total of 1,440,000 tons shown in the census report for 1929. Of this 1,300,000 tons it is estimated that 518,000 tons was produced in connection with copper smelting and 782,000 tons in zinc plants. The installed capacity is split between the two sources in the proportions of 842,000 tons from copper and 1,293,000 tons from zinc. Contact plants accounted for 306,000 tons of production and a capacity of 472,000 tons; chamber plants for 994,000 tons of production and a capacity of 1,663,000 tons.

Future of Byproduct Recovery

An effort was made to determine the probable potential byproduct acid capacity, but so few of the plants reporting were able to make this prediction that an estimate is impossible. However, it is known that much waste gas is being liberated by smelters not equipped for acid production and that few, if any, of the smelters now recovering acid are treating all of the gas available. In an opinion recently expressed by a committee of the A.I.M.E., the sulphur being wasted daily in unrecovered smelter gases on the Pacific Coast alone amounts to between 5,000 and 10,000 tons. However, against this it is to be noted that the percentage of SO_2 in smelter gases has steadily decreased in the last eight or ten years. This is due to great improvement in selective flotation which permits the mill to effect a much better separation between the sulphur-bearing gangue materials and the values. Hence it becomes increasingly evident that large quantities of waste flotation concentrates high in sulphur may some day become economically a competitor to mined pyrites.

As has been noted, total production of sulphuric acid in 1931 is believed to have been about 5,562,000 tons of 50-deg. equivalent. However, it is recognized that our information is as yet incomplete and that it may later be necessary to revise this figure upward. An independent estimate which has become available since *Chem. & Met.'s* calculations were completed increases the consumption of acid in iron and steel to 560,000 tons; in other metallurgical uses to 485,000 tons; in rayon to 153,000 tons; and in miscellaneous uses to 237,000 tons. Should this distribution prove to have been more nearly correct, the total will have been about 5,781,000 tons. In this estimate, the sources of the acid were assigned as 2,880,000 tons from sulphur; 650,000 tons from domestic pyrites (average, 42 per cent available sulphur); 951,000 tons from imported pyrites; and 1,300,000 tons from smelter gases.

Acid capacity added by new construction during the year is believed to have totaled about 93,000 tons of 100-per cent acid, all contact. Estimates place contact production at about 43 per cent of the total for the year.

World Nitrogen Developments in 1931

By CHAPLIN TYLER

Ammonia Department, E. I. du Pont de Nemours & Co.
Wilmington, Del.

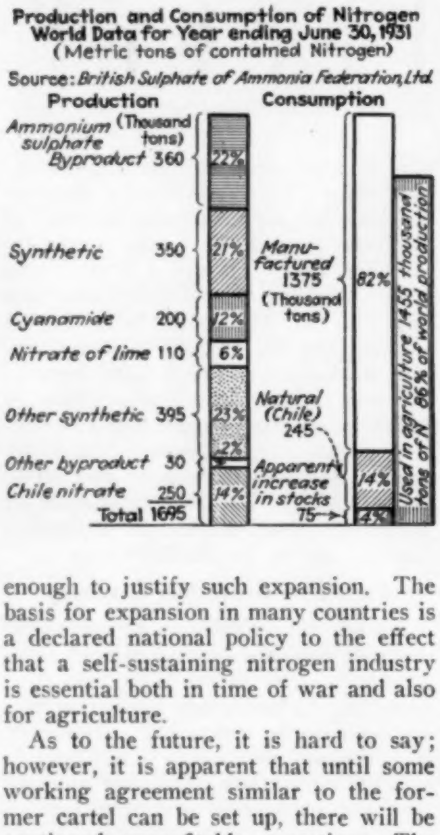
OUTSTANDING among developments of 1931 in the nitrogen industry was the complete breakdown in July of the International Nitrogen Cartel after prolonged negotiations among representatives of the Chilean and European interests. Immediately there followed sharp price reductions in the principal forms of fertilizer nitrogen. including, of course, Chilean nitrate and byproduct nitrogen, as well as the synthetic products. In order to protect home producers, embargoes on imports of nitrogen were issued by France, Poland and Czechoslovakia; and the new import taxes of Germany amount virtually to the same thing. Italy has increased all import duties on nitrogenous products, and Belgium and Japan have issued decrees requiring that imports of nitrogen be regulated by license agreements.

According to the British Sulphate of Ammonia Federation, Ltd., world production and consumption of nitrogen for the fertilizer year 1930-31 was as follows:

	—Metric Tons, Nitrogen—		
	1928–29	1929–30	1930–31
Byproduct sulphate production..........	376,000	424,440	359,594
Cyanamide production	210,000	263,800	200,932
Chile nitrate production...............	490,000	464,000	250,000
Synthetic and miscellaneous production	1,037,000	1,051,300	883,762
Total production...	2,113,000	2,203,540	1,694,288
Total consumption	1,872,080	1,950,797	1,621,305
Added to surplus...	240,920	252,743	72,983

From these figures it can be seen that world consumption in 1930-31 was 83 per cent of consumption for the peak year 1929-30; a satisfactory total, considering the general economic situation. Of the total production, only 14.8 per cent was derived from Chile nitrate, as compared with 21.1 per cent in 1929-30. An encouraging sign is the decreased surplus production, although present surplus is believed to be about 1,000,000 metric tons of nitrogen, whereas the world consumption for 1931-32 probably will not exceed 1,300,000 metric tons.

A disturbing factor in the present situation is the continued expansion of nitrogen-fixing capacity, despite reliable statistics indicating that world consumption cannot conceivably increase rapidly enough to justify such expansion. The basis for expansion in many countries is a declared national policy to the effect that a self-sustaining nitrogen industry is essential both in time of war and also for agriculture.



As to the future, it is hard to say; however, it is apparent that until some working agreement similar to the former cartel can be set up, there will be continued unprofitable operation. The producers faced with the most difficult disposal problem are those who have erected plants with the purpose of securing export business, since such producers are not only in sharp competition among themselves but are now faced with unexpected embargoes and increased duties as well.

Chile's Position

"Cosach," the organization with which the Chilean industry hoped to meet world competition successfully, already is being investigated with a view to reorganization. The position of the natural nitrate industry is not enviable. Present stocks of nitrate are said to be equivalent to 400,000 metric tons of nitrogen, which, at present rates of consumption, is sufficient to supply the world demand for nearly two years. Embargoes, or virtual embargoes, now in force in many countries will restrict the market for Chilean nitrate. Another and more serious competitive factor is the large and growing use of calcium nitrate, ammonium nitrate, and synthetic nitrate of soda. Furthermore, it is quite feasible to use the much cheaper mixture of sulphate of ammonia and limestone as a top dressing. On a nitrogen basis, sulphate of ammonia at $22 per ton is equivalent to nitrate of soda at $17 per ton, whereas it is now selling at $35 per ton, or more than double the equivalent sulphate price. In view of the foregoing factors, as well as continued improvements in the technique of synthetic nitrogen manufacture, Cosach will no doubt have to revise earlier estimates of profits.

United States and Canada

In accordance with plans, the various expansions in the synthetic ammonia industry were completed during 1931, including extensions at the Hopewell (Va.) works of the Atmospheric Nitrogen Corp., and the completion of the Shell Chemical Co. works at Pittsburg, Calif., and of the Pennsylvania Salt Mfg. Co. works at Wyandotte, Mich. The Syracuse (N. Y.) works of the Atmospheric Nitrogen Corp. was shut down after ten years' service.

As of the beginning of 1932, it is estimated that the minimum capacity of the American synthetic ammonia industry was 1,070 short tons of ammonia per day, as compared with 747 tons in 1931, 515 tons in 1930, 313 tons in 1929, and 93 tons in 1928. Present capacity, therefore, is not less than 317,000 short tons of nitrogen per year, in addition to byproduct capacity of about 200,000 short tons of nitrogen per year. Production of synthetic ammonia during 1931 is estimated to have been 200 tons per day, equivalent to 60,000 short tons of nitrogen per year, as compared with 132,000 tons of nitrogen in 1930.

Greatly decreased consumption, together with lack of tariff protection on fertilizer nitrogen and the dissolution of the nitrogen cartel, operated to force prices of sulphate of ammonia to the lowest levels in its history. Whereas in 1930 the contract price of sulphate was $41-$44 per ton, the spot price at ports in bulk was as low as $19-$22 per

Inorganic Nitrogen Production, Consumption and Capacity in U. S. A.

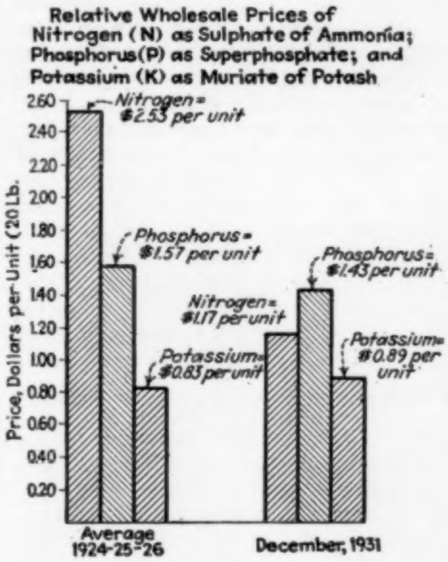
(Short Tons of Nitrogen)

Calendar Year	1927	1928	1929	1930	1931 (*Estimated*)
Production, synthetic	18,000	24,000	84,000	132,000	60,000
Production, byproduct	153,900	171,000	182,200	164,300	115,000
Total production	171,900	195,000	266,200	296,300	175,000
Imports for consumption	190,300	266,600	243,000	170,000	165,000
Total supply	362,200	461,600	509,200	466,300	340,000
Exports	35,900	25,500	46,300	35,000	37,000
Apparent consumption	326,300	436,100	462,900	431,300	303,000
Capacity as of Jan. 1	1928	1929	1930	1931	1932
Capacity, synthetic (estimated)	27,500	92,700	152,400	221,000	317,000
Capacity, byproduct (approximate)	170,000	190,000	200,000	200,000	200,000
Total capacity	197,500	282,700	352,400	421,000	517,000

ton in 1931. This compares with the following present price of sulphate in various foreign countries, per ton of 2,000 lb., delivered at nearest rail station: Germany, $30.70; England, $20.60; France, $36.97; Belgium, $20.62; Holland, $16.56; Italy, $31; Japan, $25.48; Poland, $38. It is significant that the bulk of foreign sulphate now being unloaded in the United States comes from Belgium and Holland, both of which have expanded nitrogen capacity at an inordinate rate. In order to deliver sulphate in this country at $19 per ton, it can be seen that, assuming a minimum ocean freight of $3 per ton, not more than $16 per ton can be realized by Belgian producers.

Nitrogen in the form of sulphate is now selling at a price lower than phosphorus in the form of superphosphate. These price relationships are indicated in the accompanying chart, which is based on the wholesale price of sulphate of ammonia, superphosphate, and muriate of potash, all in bags. It will be noted that the plant food in superphosphate and potash has been expressed as elementary P and K, instead of the purely arbitrary forms P_2O_5 and K_2O. Thus, the true relative low cost of nitrogen is demonstrated. While Chilean nitrate also was reduced in price from $40 to $35 per ton, nitrate still sells at approximately twice as much per unit of nitrogen as does sulphate of ammonia. This marked disparity in price will no doubt continue to encourage the use of ammonia nitrogen at the expense of nitrate nitrogen.

Apparent consumption of inorganic nitrogen in 1931 is estimated to have been 303,000 short tons, or 65 per cent of the apparent peak consumption of 463,000 tons in 1929. Imports of nitrate were maintained at the same level as in 1930; imports of cyanamide fell off sharply; but imports of sulphate in-



creased to the record total of about 100,000 short tons, equivalent to 20,000 tons of nitrogen. Belgium was the largest source of this "distress" sulphate.

Canadian requirements for anhydrous ammonia are now being supplied from the Sandwich Works, Canadian Salt Division, Canadian Industries, Ltd. Synthetic ammonia is produced there from byproduct hydrogen by the Casale process. The plant, which has operated since June, 1930, has a capacity of about 4 tons of ammonia per day.

Operations at the new $10,000,000 fertilizer works of the Consolidated Mining & Smelting Co. of Canada, Ltd., at Trail, B. C., were started during 1931. The synthetic ammonia plant comprises two Fauser units rated at 100 tons of ammonia per day. The present rate of production is from 20 to 25 tons of ammonia per day, and the output of finished fertilizer is from 200 to 250 tons per day.

The Niagara Falls (Ont.) plant of the American Cyanamid Co., which was expanded several years ago to a capacity of about 80,000 tons of nitrogen per year, operated at a greatly reduced rate in 1931. It is believed that production was between 15 and 20 per cent of rated capacity.

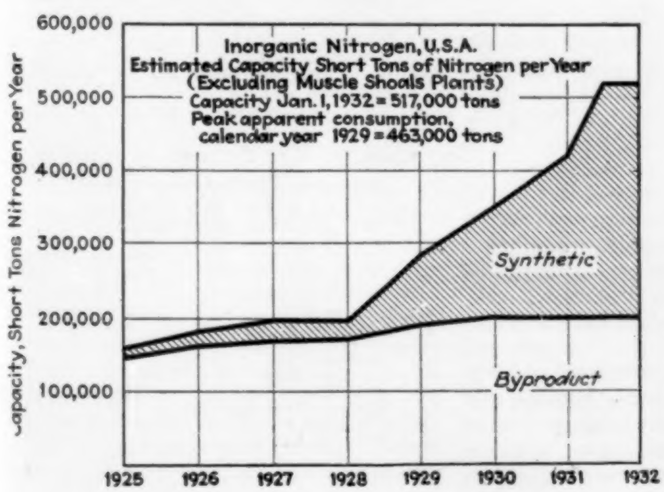
It is estimated that present Canadian capacity for inorganic nitrogen is as follows: as cyanamide 80,000 tons; as synthetic ammonia, 30,000 tons; as byproduct sulphate, 7,000 tons; total, 117,000 short tons of nitrogen.

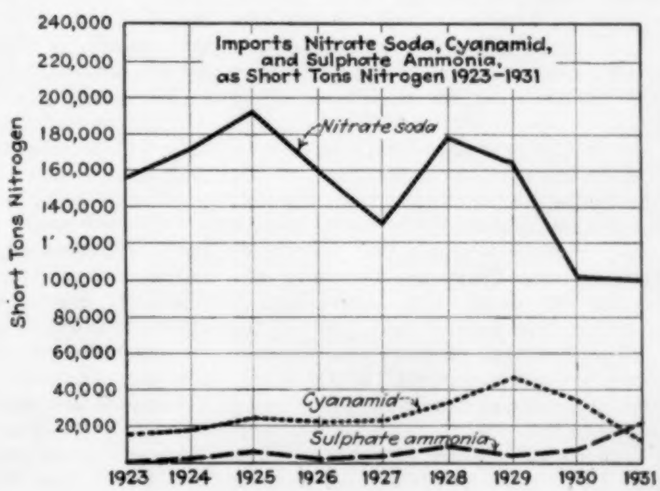
United Kingdom and Germany

As in other countries, the nitrogen industry of the United Kingdom was greatly depressed in 1931. From figures for the first nine months, it is estimated that the exports of inorganic nitrogen for 1931 were 95,000 short tons; imports, largely Chilean nitrate, were not more than 10,000 tons of nitrogen; and home consumption probably did not exceed 50,000 tons of nitrogen. Thus, the apparent production was 135,000 short tons of nitrogen.

During the year the Imperial Chemical Industries, Ltd., began the manufacture of nitrate of soda from synthetic ammonia and soda ash.

During the fertilizer year 1930-31, fertilizer nitrogen consumption in Germany was 345,000 metric tons, compared with 410,000 tons in 1929-30 and 430,000 tons in 1928-29. For this same year, it is estimated that exports of fertilizer nitrogen did not exceed 160,000 metric tons, compared with exports of 245,000





metric tons in 1929. Neglecting imports, the apparent production in 1930-31, therefore, was 505,000 metric tons, or about 50 per cent of the German capacity, which is somewhat more than 1,000,000 metric tons of nitrogen per year. Owing, however, to the large stocks of nitrogen fertilizers, said to be in excess of 300,000 tons of nitrogen, it is doubtful whether the actual production was more than 30 per cent of capacity.

It was reported that during the last months of 1931 the production at the Merseburg works of the I.G. had declined to less than 20 per cent of the rated capacity of 625,000 metric tons of nitrogen per year. Despite repeated reductions in price, nitrogen fertilizers have not moved satisfactorily, either for home consumption or for export. Since nitrogen products comprise such a large proportion of I.G. sales, it is certain that net profits for 1931 will be far below those for 1930.

Demand being at such low ebb, it has been necessary to close several works: viz., the Piesteritz cyanamide works near Wittenberg, the Chemischwerke Lothringen near Bochum, and the Stickstoffwerke A.G. at Waldenburg, the latter being a synthetic ammonia works of recent construction and having a capacity of 22,500 metric tons of nitrogen per year.

Another development of interest in German nitrogen affairs was the Reich order of July 13 regulating imports of fertilizers through heavy import duties. For example, the tax on imports of nitrate of soda and sulphate of ammonia is 12 marks per 100 kilos, or $28.60 per metric ton.

France and Japan

On Dec. 28, the French Ministry of Agriculture announced that it had signed an accord with German producers "to buy nitrate in sufficient tonnage to satisfy the needs of French agriculture and industry." It is expected that during 1932 about 150,000 metric tons of nitrates will be supplied to France through the I.G. Farbenindustrie, which, added to 200,000 tons recently purchased from the Chileans, will satisfy the total annual needs of 350,000 metric tons of nitrates. The deal will permit the French consumer to purchase nitrate fertilizer at a new low price of 95 francs per 100 kilos, or about $34 per short ton.

In 1930, the production of nitrogen in France increased to 97,800 metric tons, but during the fertilizer year 1930-31, production decreased to 79,400 metric tons. Since it is stated that imports of nitrates from Chile and Germany will be 350,000 metric tons, equivalent to 60,000 metric tons of nitrogen, it can be assumed that present total requirements are not more than 140,000 metric tons of nitrogen, nearly 40 per cent of which is imported.

Imports of sulphate of ammonia during 1930 were 305,000 metric tons, equivalent to 63,000 metric tons of nitrogen. Owing to the rapid expansion of the home nitrogen industry, and to the depressed condition of agriculture, it is expected that imports for 1931 will not exceed 170,000 tons of sulphate. So rapid is the expansion of sulphate production in Japan that it is possible that within a year or two no sulphate will be imported, whereas in the past Japan has been the world's largest importer of this commodity. In November, the departments of Commerce and Agriculture agreed upon a license system to govern the importation of sulphate of ammonia; whether this will operate as a virtual embargo on foreign sulphate is not yet known.

It is estimated that in 1932 Japan will consume not more than 700,000 metric tons of sulphate, equivalent to 150,000 tons of nitrogen, whereas a total of 740,000 tons of sulphate is scheduled to be produced. Among new developments are the projected works of the Miike Nitrogen Co., organized by Mitsui to produce initially 30,000 tons of sulphate utilizing the Claude ammonia synthesis; and completion of two-thirds of the plant of the Chosen Nitrogen Fertilizer Co., subsidiary of the Japan Nitrogen Fertilizer Co. When completed, the Chosen plant will have a capacity of 400,000 metric tons of sulphate, equivalent to 83,000 tons of nitrogen. It will therefore rank as one of the world's largest nitrogen works.

Netherlands, Norway and Poland

Rapid progress has been made by the Netherlands nitrogen industry. The minimum capacities of the three synthetic ammonia plants are as follows: Sluiskil, 40,000 tons; Lutterade, 36,000 tons; Ijmuiden, 15,000 tons; total, 91,000 metric tons of nitrogen per year. Since there also is a considerable output of byproducts nitrogen, the present nitrogen industry has a capacity of about 100,000 metric tons per year.

Increased production of sulphate of ammonia has enabled the Netherlands to become an important factor in export trade. For 1931, exports of sulphate will be equivalent to nearly 50,000 metric tons of nitrogen, an increase of nearly threefold over 1930. Imports of nitrogen, mostly as nitrate of soda, calcium nitrate, and sulphate of ammonia, were 76,000 metric tons of nitrogen in 1929; 33,000 tons in 1930; and for 1931 probably will be reduced still further. The Netherlands is therefore more than self-sustaining as regards nitrogen.

Of the major nitrogen-producing countries, Norway alone has attained a fair ratio of production to capacity. The reconstructed works of the Norsk-Hydro at Rjukan, said to have a capacity of 90,000 metric tons of nitrogen per year, produced 83,000 tons in 1930. Cyanamide production was equivalent at least to 10,000 tons of nitrogen, making Norway's total production of nitrogen in 1930 at least 93,000 metric tons, of which about 73,000 tons was exported, largely as calcium nitrate, cyanamide, and synthetic nitrate of soda. Norway imports virtually no nitrogen. In 1931, it is estimated that the Norsk-Hydro works produced 70,000 tons of nitrogen, whereas cyanamide production probably declined to an insignificant figure, owing to the loss of export markets. Exports of all nitrogen products in 1931 is estimated to have been only 40,000 metric tons as nitrogen.

With the completion in 1930 of the Polish nitrogen-plant construction, this country became self-sustaining as to all major nitrogen products, including cyanamide, sulphate of ammonia, nitrate of soda, and ammonium nitrate. The following table shows the comparative statistics for the calendar years 1929 and 1930:

	Metric Tons Nitrogen 1929	1930
Production	47,000	42,300
Imports	20,000	12,100
Exports	6,700	12,600
Apparent consumption	60,300	41,800

While no figures for 1931 are yet available, it is believed that the apparent consumption of nitrogen will not exceed 30,000 metric tons. Most of this will be supplied from domestic production, since the Polish government issued an embargo on nitrogenous fertilizers, effective July 21.

Synthetic Ammonia Shows Large Decrease

AN AVERAGE daily output in the United States during 1931 of approximately 220 short tons of synthetic ammonia is indicated by preliminary information available at this time to the editors of *Chem. & Met.* It will be noted that this estimate is about 10 per cent more than that given by Mr. Tyler in the preceding article and is, therefore, subject to revision when further reports are received. Even the higher figure represents a decline of 50 per cent from the record total reached by the industry in 1930. The only new plant not listed in the following table is that of the Pennsylvania Salt Manufacturing Co. at Wyandotte, Mich. Its output of 6 tons per day will be available in 1932.

Chem. & Met. Estimates of Synthetic Ammonia Production, 1930-1931

(All figures in short tons of ammonia per day)

Plant	Average Output for 1930	Average Output for 1931
A.N.C. Hopewell, Va.	270	100
A.N.C. Syracuse, N. Y.	40	...
Du Pont, Belle, W. Va.	120	80
P.A.C. Seattle, Wash.	3	3
R. & H. Niagara Falls	3	5
Mathieson, Niagara Falls	12	8
Great Western, Pittsburg, Calif.	2	3
M.A.C. Midland, Mich.	4	4
Shell, Pittsburg, Calif.	0	15
Total	454	218

Coal Products at 1905 Level

COKE PRODUCTION in 1931 was at the rate of approximately two-thirds that in the preceding year. The output of byproduct coke was 32,500,000 tons and of beehive coke 1,300,000 tons; these quantities represent 72 per cent for byproduct and 50 per cent for beehive of the output of the preceding year. The total production, approximating 33,800,000 tons, about equaled that of 1905. Only two intervening years, 1908 and 1921, reported lower production.

As might be expected, the production from byproduct plants affiliated with blast-furnace enterprises declined more than the production from independent or merchant plants. The output of these "furnace" plants was approximately 62 per cent of the country total in 1931, as contrasted with 73.6 per cent of the total production in the preceding year.

Stocks of coke on hand Dec. 1, 1931, were nearly a million tons greater than the year before, being 4,290,000 tons, as reported by the U. S. Bureau of Mines. The increase in stocks of byproduct coke in the hands of producers was about equally divided between stocks at plants affiliated with blast furnaces and those doing a merchant coke business. Stocks at merchant plants continue the higher, amounting to 2,475,000 tons out of the total.

New Byproduct Coke Works

Byproduct production continued along conventional lines, amounting to approximately 72 per cent of the output for 1930. On this basis the estimated production during the calendar year 1931 was as indicated in the accompanying table.

Two new byproduct works were reported as beginning operations during the year. At the Hunts Point plant of the Consolidated Gas Co. of New York, 37 new Koppers ovens began operation in January. In November a plant of 25 Semet-Solvay regenerative ovens began to push coke at the Ironton (Ohio) plant of Ironton Byproduct Coke Co. At the end of the year, 86 plants were operating at an estimated rate of approximately 45 per cent of their maximum regular producing capacity. Earlier in the year the maximum number of plants operating any one time was 88.

Sale of gas from byproduct works for public-utility distribution was continued in 1931 on approximately the same basis as during the preceding year. Even in such communities as Chicago, where natural gas became available in large quantities for the first time, the use of byproduct gas was not discontinued. In most cases mixtures of oven gas and natural gas are now being sold for city supply under these circumstances. In Chicago the mixture so distributed is of about equal volumes of the two constituents and averages 800 B.t.u. per cu.ft. in heating value.

During 1931, for the first time in many years the imports of ammonium sulphate were greater than the exports. This return of the United States to an importing status came about largely through the sale of distress stocks of European sulphate under conditions that led to the charge of "dumping." The result of the large imports and of the restricted foreign market for domestic production was an almost complete collapse of prices during the spring and early summer. At times sulphate was sold on the American market at less than $19 per ton. Quoted prices have continued on a higher level, and at the close of the year the nominal price was approximately $20. This represents a figure of about 60 per cent of that of the preceding year.

Low Ammonia Prices

As a consequence of low ammonia prices, numerous byproduct operators have chosen to curtail materially the production of ammonia. In some cases all of the fixed ammonia in the liquor is being discarded. In other cases ovens are being deliberately operated under conditions that will reduce the yield in the crude gas. As a consequence it may be anticipated that the average recovery of ammonia per ton of coal carbonized will be less in the future than in the recent past. This fact has been taken into account in estimating the total production in the United States during the past year.

Coke and Byproducts in 1931

(Production estimates by *Chem. & Met.*, not including gas-retort plants)

Coke made:	Short Tons
Byproduct ovens	32,500,000
Beehive ovens	1,300,000
Total	33,800,000
Ratio to previous years' operations:	Per Cent
Byproduct ovens	72
Beehive ovens	50
Total	70
Byproducts made:	
Gas, total, billion cubic feet	520
Light oil, crude, million gallons	130
Tar, million gallons	430
Ammonia, total calculated as sulphate, tons	520,000

A somewhat similar situation with reference to a curtailed market for tar has resulted in a greater tendency toward the burning of tar as a boiler or furnace fuel. For such use where tar is directly competitive with fuel oil the price, of course, is correspondingly low under present conditions. Light oil, used principally for motor-fuel blending, suffers correspondingly in price from the low levels of gasoline price. In general, therefore, the reduced credit for byproducts has tended to increase the net cost to the user of either oven gas or coke, or both. On the average, the effect has in some cases been as much as several cents per thousand feet of gas, or as much as 50c. per ton of coke.

City Gas in 1931

MANUFACTURED GAS sales in 1931 declined only 2.5 per cent from the 1930 figure, according to estimates of American Gas Association. An outstanding exception to the declining trends was the 20 per cent increase in sales of manufactured gas for house heating purposes, from 18,600,000,000 cu.ft. in the preceding year to 22,200,000,000 in 1931.

Despite large expansion of the natural-gas distributing systems of the country, there was a small decline in total sales for the country for domestic and commercial purposes, amounting to a little less than 2 per cent. The decline in natural-gas sales for industrial purposes, however, was larger, being approximately 15 per cent, according to estimates of American Gas Association. Still larger declines occurred in natural-gas usage for non-utility purposes, including manufacture of carbon black and operations in the oil and gas fields; this decline is estimated at about 28 per cent, as compared with the preceding year. In the aggregate, therefore, the use of natural gas in 1931 is estimated at approximately 20 per cent less than in the preceding year. The extensions of systems, particularly the construction of long-distance pipe lines, during the year was estimated to have amounted to $300,000,000.

Production of Specified Coal-Tar Intermediates in 1930

	[Lb.
Acetaldehyde and aniline condensation products	1,615,381
H acid	2,337,311
Aniline oil	26,388,177
Anthraquinone salts	692,414
Benzidine base	499,949
Cresylic acid, refined	17,305,308
Dibutyl phthalate	1,960,351
p — Dichlorobenzene	5,947,617
Dinitrobenzene	1,338,580
Dinitrochlorobenzene	5,074,504
Diphenylguanidine	1,634,837
Gamma acid	527,212
Metanilic acid	472,441
Naphthalene	31,955,635
a — Naphthol	801,800
Naphthionic acid	853,232
Nitrobenzene	39,210,718
Nitrotoluene	5,552,402
p — Nitrotoluene	1,420,201
Phenol	21,147,436
m — Phenylenediamine	670,521
Phthalic anhydride and acid	6,693,001
Salicylic acid, tech	2,909,2[illegible]
Sulphanilic acid	1,180,758
o — Toluidine	1,260,580
Total intermediates	290,760,532

Plastics Resist General Trend

WHILE the contraction of general business had a disappointing effect on the plastics industry just when it was gaining full motion, its very youth has been responsible for the comparative gains which maintain it above present average activity. This condition, true in 1930, has continued through the further recession of 1931; but meanwhile its actual volume of sales and production has also declined. Considering general business at about 37 per cent below its normal course (1924-1928), plastics can be estimated at about 25 per cent below—an entirely theoretical figure, however, because of the infancy of the industry at that time. As a whole it averages some 40 per cent under the peak year 1929.

The embarrassing factor continues to be the producers' market, which originally formed its foundation. Electrical goods, radio-tube bases, automobile fixtures, all are suffering from the depression's effect on their parent industries. And it is chiefly the unfolding of new markets, as predicted several years ago, that has to some extent retrieved this loss. A full expansion of these new fields will also have to await a general stabilization of business; meanwhile they are benefiting different types of material. Clock cases and containers are examples.

Many of the newer materials are contending particularly for the "color" market; that is, applications where a great variety of attractive colors is desirable. It has been computed that this market represents a potential limit of 5,000,000 lb. of plastics and of $3,000,000 in sales, to put it liberally. Hence it is evident that color alone cannot transform a material into a large industry, as was already pointed out here last year.

Three types of products, of plastic origin, are not generally included in a discussion of the industry: wrapping material, film, and varnish ingredients. The latter are treated comprehensively on a later page and statistics for the other two groups have not been made available. Wrapping material of viscose is now made in greatly increased quantity by two companies, and at least two others hope to share in the field with cellulose acetate.

According to latest official figures, the foreign markets do not play a large rôle in domestic industry, apart from branch factories located abroad. In some respects the European nations have adopted plastics more quickly than here; for example, urea-formaldehyde in England and casein in Germany. In Germany the industry as a whole looks to a great immediate expansion because of expired outside patents and cheap raw materials. Injection molding has also long ceased to be a secret there—even an "open" one.

Cellulose Compounds

Pyroxylin, or nitrocellulose, plastic has receded slightly from its position of 1930, its production in 1931 being estimated at about 16,000,000 lb., exclusive of film, valued at about $19,000,000. This is still considerably in excess of the dollar sales of any other branch of the industry, even with a chief quality consumer—safety glass—rather dormant at the time. In terms of chemicals consumed it represents roughly 8,000,000 lb. of cotton linters, 18,000,000 lb. of acid (sulphuric and nitric), 8,000,000 lb. of alcohol and 4,000,000 lb. of camphor. Prices vary greatly with color and quality, running upward from 50c. per pound. A fair average would be about $1 per pound, combined sales value cited above representing some material fabricated by producers.

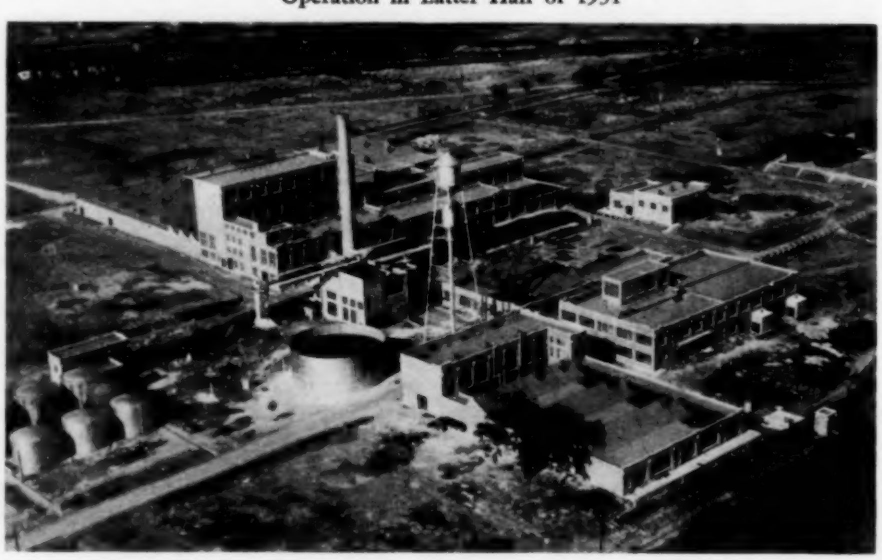
Markets and prospects remain much the same, with the fountain-pen barrel playing a steady and conspicuous part, in fact, practically all pen makers have adopted pyroxylin. Pigmentation has effectively widened the household applications through reduction of the fire hazard. The phonograph record development apparently has lost out to other materials for the time being. During the year there was extensive realignment of safety-glass producers, resulting in the concentration of facilities within a few large companies and in the disappearance of several others. The comparative idleness of the industry greatly curtails an advantageous outlet for pyroxylin plastic.

Cellulose acetate has become a minor but versatile factor in several fields. Its 1931 production, exclusive of films and yarn, has been estimated at around 100,000 lb., representing a value of about $150,000. Most of this quantity went into standard shapes, sheets, and insulation (coating and flake). Three concerns are primarily interested and two are already producing molding powders. The price is still above that of the nitrate, but is expected to decline with expanding sales and lower material costs. A new process for synthetic acetic anhydride, at substantially lower cost, is foreseen for the coming year.

During the past year, wrapping material of cellulose acetate has made its public appearance, offering high-moisture resistance, great clarity, and heat-sealing as principal advantages. For special conditions acetate is competing also with pyroxylin as a safety-glass constituent, because of its greater stability to light. A problem that has delayed its wider use generally has been a suitable combination of plasticizers, or better some universal plasticizer, such as camphor in pyroxylin plastic.

Last year it was mentioned here that other cellulose esters might soon be heard from. Nothing startling has occurred, but during the year a large

Bakelite Corporation's New Plant at Bound Brook, N. J., Completed and in Operation in Latter Half of 1931



number of patents on the higher esters, such as propionate butyrate, and stearate, was reported. That they have special valuable properties accounts for the activity in their development.

Phenolic Resins

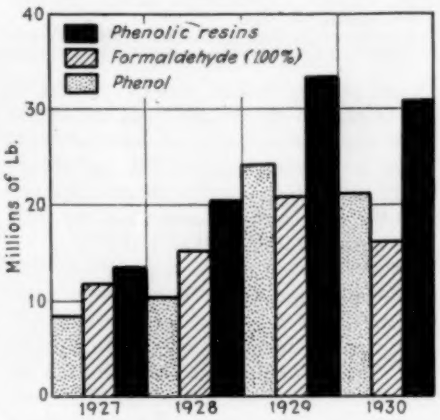
As in the past, this group is assumed to cover all materials of the type phenol-formaldehyde—that is, including those made from cresol, coumarone, indene, resorcinol, furfural, hexamethylenetetramine, and so on. It might be added at the outset that the proportion of the various constituents in the total output varies from year to year; that recently the constituents other than phenol captured an unusually large share.

Compared to a production of 30,800,000 lb. in 1930 and 33,000,000 lb. in 1929 (see diagram), the resin output of 1931 showed another recession to about 25,500,000 lb., a loss of roughly 20 per cent. Of this quantity, molding powder had the greatest share, some 19,000,000 lb., while the remainder went into laminating varnish. The total value may be estimated at $8,000,000. Phenol production was about 18,000,000 lb. (with synthetic sharing less than before), and formaldehyde production about 13,000,000 lb. for the year; wood flour consumed by the resin industry fell from 5,000 to under 4,000 lb. It will be seen from the accompanying table that the quantities involved are very considerable (phenol and formaldehyde shown are totals, but fluctuate with the resin consumption); nevertheless, the figures are not far above those of pyroxylin and serve to indicate what possibilities will materialize when confident times permit phenolic resins to become more firmly established.

That unit costs have remained steady throughout the year is seen in the present quotation of black or brown molding powder, 17c. per pound. On the other hand, compounds have appeared at a lower price, unindorsed by the leading companies and presumably of uncertain quality. Phenol and formaldehyde prices also have shown little fluctuation, the respective quotations being 14 and 6c. per pound (40 per cent formaldehyde). After the immense expansion in production facilities for both materials, plants have been operating far under capacity and there should never again be such a shortage as several years ago. Nor is the price expected to vary much in the future.

A promising outlet for resins a year ago has meanwhile gone far to fulfillment: namely, closures. Tube caps have been supplemented by jar caps, and even sizable jars and boxes. The cost competition with other materials has been met in some cases on equal terms; in other cases the appearance overcomes a disadvantage; and in still others the "re-use" possibility has been exploited—perhaps not too wisely. At any rate, closures have greatly aided the industry, while its normal outlets have declined. Other markets that have been successfully expanded are those requiring accurate, mechanically strong material, such as pipe fittings. These depend largely on development of the proper stock by the plastic manufacturer.

Resembling hot-molded phenolic resins in composition are the cast phenolic plastics which have returned to prominence this year. The original producer is still the leading factor, although other firms have sprung up since then. The output, which was less than 250,000 lb. in 1930, is reported to have increased to 500,000 lb. in the past year. The price has been reduced to 70c. per pound, but of course this is attractive only where the brilliant colors and easy workability can be used to real advantage.



Domestic Production of Phenolic Resin and Raw Materials

Urea-Formaldehyde Resins

The year has seen the firm intrenchment of urea-formaldehyde resins among the larger producing plastic groups in this country, although England and Germany have already been receptive markets for a number of years. The features of this period were a reduction of prices to more competitive levels, a greatly increased production, and the entrance of new interests into the field.

Apparently production estimates for 1930 will have to be considerably magnified, for the authoritative figures for 1931 indicate an output above 800,000 lb., and represent a 50 per cent growth over the previous year. This entire quantity finds use in colored objects, but the principal use of the previous year, tableware, has been widely supplemented by such outlets as clockcases, containers, and electrical fixtures, mainly in thin sections. For this year a further increase in output is predicted.

All urea-formaldehyde plastic is sold as powder ready for molding. Formerly the price was fixed at 60c. per pound, but this year it has been reduced to 35c. per pound for standard colors and 48c. for the thio-urea base material, which, however, is in diminishing demand. With formaldehyde at 6c. and crude urea at about 5c. per pound, the prospects for successful maintenance of this resin's position are unusually favorable.

At the beginning of the year, two companies were the principal American producers, under a complicated patent situation that resulted in a suit, not yet settled. Subsequently, two further companies entered the field (see *Chem. & Met.*, October, 1931, pp. 583-584), but by the end of the year had not yet attained full operation. One of these firms is working under patents of the German I. G., which in turn is licensed for Europe under the same early Pollack patents controlled in this country by one of the original American producers. This statement is considerably less complicated than the eventual disintanglement will be, if it ever comes.

Other Plastics

The styrol and vinyl compounds produced in this country display some analogy of composition as well as of development. The two large companies backing them have been content to perfect them gradually without bringing them to premature public attention. Their plastics were both produced commercially during 1931, but in plant units that grew only in accordance with actual needs. Thus the annual production now runs at a rate of several hundred thousand pounds, new units being expected to increase the output for 1932.

The vinyl compound's first large user was the phonograph company which contracted for a considerable quantity late in 1931. The styrol plastic, on the other hand, has come into increasing demand for high-frequency radio equipment—coils, panels, etc. It is now available as standard shapes and molding powder; and during the year its elasticity and mechanical strength have been increased.

Incidentally, it is interesting to note that a leading German plastic producer has added to his regular output a styrol compound intended for injection molding.

Of the remaining plastic compounds it may briefly be said that not much change has occurred during the year. The cheap and serviceable asphalt types are used for battery and radio cases; in the stress of the year they have also usurped some applications of the phenol-formaldehyde resins where requirements are not too severe. Figures on casein-formaldehyde have not been obtained. Its principal use is in buttons, where it has captured some 65 per cent of the entire trade; but for most other applications its properties have not yet been adequately developed. Those who have expected to find the world gradually converted into polymerized sugar will do well to divert their attention for some time. The sugar plastic announced last summer has yet to become a practical reality.

Rayon Output Up; Profit Down

"PROFITLESS PROSPERITY," the slogan so often heard during the final years of the pre-depression boom, may well have been adopted as its own by the rayon industry in 1931 —with the difference that for rayon the year was busy but truly profitless. This is the opinion of well-informed observers, whose calculations indicate that profits were practically nonexistent, despite the fact that production at least equaled that of 1929, and may have exceeded it considerably. Producers are reticent about production figures, especially at present, and it is quite unlikely that the early estimates, based on fairly accurate data for the first seven months, will be fulfilled. *Textile World's* first estimate of 161,-165,000 lb. was given with the proviso that it might later be reduced to about 140,000,000 lb. Other estimates have placed the figure at from 120,000,000 to 123,000,000 lb. But without complete figures it now appears that actual production must have been in the neighborhood of 140,000,000 lb., as compared with 123,130,000 lb. in 1929 and 119,-000,000 lb. in 1930. Unofficial estimates divide this production into 13,000,000 lb. of acetate, 7,000,000 lb. of nitro, 2,500,000 lb. of cupra-ammonium, and the remainder—117,500,000 lb.—viscose rayon. Should it later be necessary to revise the total downward, practically all of the revision will be made in the viscose figure.

Estimates of world production for the year place the total at 431,880,000 lb., divided between 374,920,000 lb. of viscose, 39,670,000 lb. of acetate, 11,-550,000 lb. of cupra-ammonium, and 5,740,000 lb. of nitro rayon. Since these estimates were published it has become probable that the figure for nitro will be increased by about 2,700,-000 lb. Should these estimates prove to be approximately correct, it will be evident that United States production was about 32.5 per cent of the world production in 1931, as compared with 31.5 per cent in 1929. Viscose plants in the United States apparently operated at about 70 per cent of capacity, acetate at 56 per cent, cupra at 50 per cent, and nitro plants at 88 per cent. The low showing for the acetate industry is due very largely to the fact that several of the five producers have plants which were only put into production within the last two or three years and have been slow in working up to capacity. The most recent of the acetate silk producers, Tennessee Eastman Corp., started commercial production on a plant scale in October, 1931.

So far as inventory is concerned, the producers evidently were in very good

Rayon Production and Imports, 1922-1931

(Tariff Information Survey and *Textile World*)
Thousands of Pounds

	U. S. Production	U. S. Imports	World Production
1913	1,566	2,306	29,156
1922	24,406	2,088	80,894
1923	35,400	3,906	108,800
1924	38,750	1,712	141,164
1925	52,200	7,001	182,984
1926	62,575	10,127	219,080
1927	75,050	16,223	266,868
1928	98,650	12,754	347,400
1929	123,130	15,902	404,155
1930	119,000	5,810	416,775
1931	140,000*	2,260†	431,880*

* Estimated; see text.
† Estimated on basis of first ten months reported imports; does not include waste,staple or spun threads

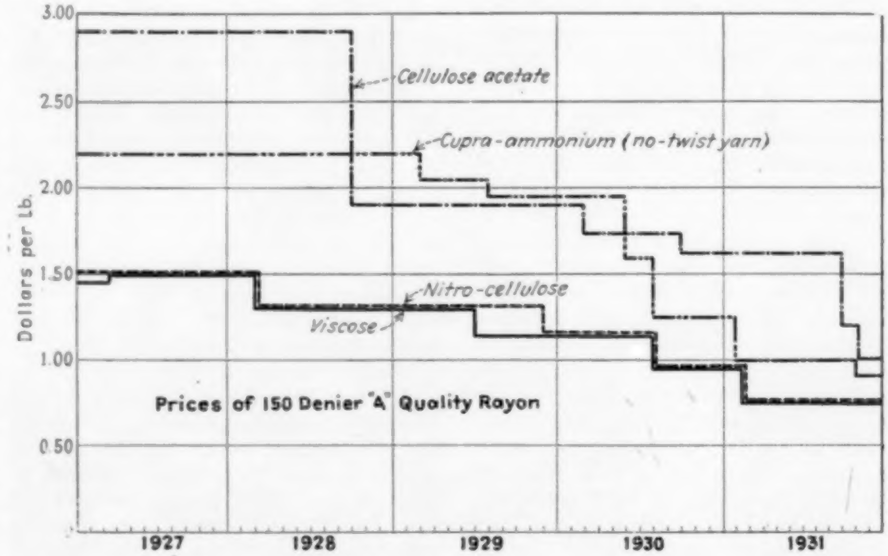
shape at the end of 1931. Stocks of 25,000,000 to 30,000,000 lb. at the end of 1930 were decreased to about 10,000,000 lb. or less as of Jan. 1, 1932. With imports estimated at only about 2,260,000 lb., the apparent consumption in 1931 was close to 160,000,000 lb.

With the exception of a newly announced process for cupra-ammonium rayon which may prove to be of much importance, technical developments of the year seem to have been limited almost entirely to an extension of the investigations that have been carried on in the past and to the refining of existing processes to meet the much more stringent price situation. Price reductions undoubtedly were the most important feature of the year. The chart reproduced here, for which the quotations were chiefly supplied by *Textile World,* shows very clearly the part that price has played in recent years. Viscose and nitro, always nearly equal in price, have declined in five years from $1.50 to $0.75 per pound of 150 denier standard rayon. Acetate at $2.90 and cupra at $2.20 per pound of the same denier and quality in 1927 have very nearly reached the level of viscose, with acetate at $0.90 and cupra at $1 at the close of 1931. This seems to refute the belief once expressed that the viscose process would always produce the cheapest rayon. As a matter of fact, estimates indicate that the present selling price of viscose is little, if any, above its gross cost, while acetate, in the opinion of at least two authorities, may eventually become even cheaper to produce than viscose. The new cupra-ammonium process referred to, announced within recent months by the Furness Corp., Gloucester, N. J., has been claimed to offer even more startling cost reductions.

This concern has developed an entirely new technique from start to finish of the cupra-ammonium process. The product is said to be of high quality and good appearance. The process of dissolving the cellulose has been greatly simplified and requires a total time of only five hours. However, it is in the spinning machine where the greatest improvement has been made. With a minimum of attendance, the new machine spins, washes, dries, and twists the product in three minutes. So simple is operation and maintenance that the Furness Corp. proposes to supply spinning machines to rayon users, who will then be able to produce for their own consumption. For such users a chemical department will be unnecessary, as the cellulose solution can readily be shipped to them in tank cars.

Among other technical developments may be mentioned further investigation of new cellulose sources. Southern pine appears to be a possibility. Apparently little progress has been made in special processes such as the Lilienfeld, said to give a very high strength viscose product. Various methods of dispensing entirely with cellulose have been proposed, but nothing has progressed beyond the curiosity stage, or in most cases, the field of pure conjecture. Probabilities are that processes very similar to those now in use will continue to be the only ones of importance for years to come.

Five-Year Price Trend for Four Principal Rayons



Resins in Paint and Varnish

Unquestionably the most important current development in the paint and varnish industry is the expanding use of synthetic resins. The application in varnish of this variety of resin began only a few years ago, but has spread rapidly to lacquer and paint. And more satisfactory results are being obtained now that the resin and finish manufacturers have realized the importance of cooperation in adapting these materials to paint, lacquer, and varnish compounding. As in the case of the natural resins, the synthetic materials offer many types. Manufacturers have expanded their line from a single product to a series of resinous products with a large variety of physical properties.

Natural fossil resins, such as kauri and copal, possess certain objectionable features that the synthetic lack. Their supply is limited, while that of the synthetic is inexhaustible; and the user must contend with uncertainties that are peculiar to all imported raw materials, that is, irregularity of supply; and because of their nature the composition and physical properties necessarily are not constant.

But natural gums are not the only raw materials that are experiencing the effects of competition from synthetic resins. By the use of certain of these resinous materials the nitrocellulose content of the lacquer and the quantity of drying oil usually employed may be reduced to the advantage of the product. Development of these resins has permitted the use of cheaper solvents.

Among the important synthetic resins that are now available and are used in rapidly increasing quantities are: the ester gums; and paracoumarone-paraindene, chlorinated diphenyls, phenol-formaldehyde, petroleum and glycerol phthalate resins; and resins prepared from acetylene.

As previously stated, certain resins influence the properties of nitrocellulose-lacquer compounds. These resins greatly increase durability and resistance of the lacquer films to sunlight. Before the use of these materials, it had been impossible to produce clear or unpigmented nitrocellulose coatings that would be durable when subjected to ultra-violet light. The new resins make it possible to produce clear finishing lacquers that are more durable than high-grade natural resin varnishes when exposed to the weather on either wood or metal surfaces. Pigmented lacquers compounded with these products are also more durable, especially on wood, and chalk less than other types of lacquer.

One of the most recent developments in the finishing of automobile bodies involves the application of lacquer enamels made with synthetic resins. This industry has found that by adjusting baking and finishing schedules it can use a product containing from three to four parts of synthetic resin to dry nitrocellulose and a small quantity of plasticizer. The advantage lies in the fact that viscosities are reduced and higher solids are obtained at spraying weight. This results in fewer coats and a saving in labor and solvent. After forced drying the enamel gas-sands excellently. It can be mist-coated and baked to a high luster with a minimum of rubbing and polishing.

Special Finishes

Modern synthetic resin finishes have very recently been developed for both air dry and bake treatment. Instead of the customary period of several days normally required in the application of the filler and the final rubbing of the last varnished coat, it is possible to apply the complete finish in the space of a few hours, producing thereby a finish that in quality is far superior to that obtained by the ordinary varnish. In this same industry these materials are being used to some extent as a sanding sealer to fill holes and also for top coats on the same article.

Several resins have recently been developed that can be used in admixture with cellulose acetate and with cellulose ethers. A number of special grades are available in both oxidizing and non-oxidizing types which are essentially acid polyesters and which, when combined with ammonia, become water soluble. Such solutions have many interesting and useful properties.

Many resins give rapid drying products which have better adhesion to metallic surfaces than the older types. In some the priming coat is unnecessary.

During the past year at least one important manufacturer has gone a step farther and made available to the paint, varnish, and lacquer manufacturers synthetic resins processed with such other ingredients as drying oils and plasticizers, which in many cases relieve the manufacturers of further cooking. All that remains to be done is to mix these processed materials with the pigments, solvents and driers.

White Pigments

An interesting development of last year has been in the zinc sulphide pigments. The use of barium-base lithopone has been steadily growing, and during the last year the corresponding calcium-base pigment has been put on the market. The latter gives an interior finish of unusual leveling, brightness, and light reflection. Straight zinc sulphide has been introduced in outside paints.

Zinc oxide has the distinction of being the only white pigment whose price has remained stationary. This is a remarkable feat in view of the general trend of prices of materials for similar purposes and of the introduction into the field of a new producer, the St. Joseph Lead Co.

The process employed by this company marks a distinct departure in the methods of producing zinc oxide directly from zinc-bearing ores. The process depends: (1) upon a treatment of the ores to insure the removal of impurities which would affect the finished product; and (2) upon the continuous smelting operation, which insures uniformity of the finished product. Uniformity is not obtained by blending the production of several furnace charges, as has heretofore been the case.

Although most white pigments suffered during the past year from the general depression in business, the infant of the industry, as might be expected, has gone countercurrent to its bigger brothers. Titanium pigments have greatly improved their position, but, compared to the production of others, theirs is still small.

While the consumption of pure titanium oxide has increased, most of this demand has been for the barium-base titanium pigment, but the more recently introduced calcium-base material has been favorably received. Applications for the newer pigment include interior wall flat paint, and enamel undercoats and top coats. Another use of titanium pigments is in a mixture with lithopone to produce the so-called titanated lithopone. During the year a new producer of titanium pigments, the Southern Mineral Products Corp., a subsidiary of the Vanadium Corp. of America, commenced operations at its Piney River plant in Virginia.

The sales of white lead, the oldest of all white pigments and for many years the only white pigment in use, decreased about 5,000 tons during the year. The total dry white lead and that ground in oil shipped in 1931 is estimated to have been 110 000 tons.

Fertilizer Trade Faces Many Problems

FERTILIZER markets are suffering even more severely than most others from the economic depression. And even worse prospects seem ahead. The gross agricultural income of the United States has declined from approximately twelve billion dollars in 1929 to not over seven billion dollars in 1931; the gross crop income, perhaps a better measure of potential fertilizer market, has been approximately eight billion dollars in 1929, six billion dollars in 1930, and four billion dollars in 1931. Hence it is not surprising that the 7,000,000-ton market of the fertilizer year 1929-1930 suffered a decline of 10 per cent during the fertilizer year closing in 1931. A composite of experienced estimates indicates that not over 4,500,000 tons of fertilizer can be expected to find sale during the coming year.

Congress, with its legislative pulmotor, is undertaking to resuscitate agriculture. It is obvious, however, that 6c. cotton and 50c. wheat cannot be offset by any Congressional panaceas within any short period. Agricultural credit is not available, therefore, for fertilizer purchases on the customary scale. Furthermore, local banking facilities, restricted by frozen security and crop loans, make local banking credit less than usually available to crop growers.

The significance of this situation on the distribution trends or the corporate developments of the industry is not easy to appraise. One of the sagest interpreters of the industry suggests, however, that it may well mean a sharp reduction in the number of small fertilizer companies which have limited credit resources. Larger companies, with greater financial backing, may be able on their own resources to extend needed credit to the agricultural community for fertilizer purchase. To the extent that a company can do this it may look forward to a greater than usual share in the market. If its selection of credit risks is wise, the result should be a long-time beneficial effect on the magnitude of its business.

But the desirability of extending credit so widely to fertilizer purchasers becomes rather questionable in the light of 1931 experience. The cash price, customarily about 10 per cent below the credit price, actually returned more money to the industry per ton of goods sold last year. The uncollectable accounts were so high in the credit group as to be more than enough to offset the 10 per cent price differential. Many companies are, therefore, naturally asking themselves, Why should we take so much of a chance for so narrow a percentage difference? With the keenly competitive market situation it is not expected that much can be done to change credit charges this year, but the industry is thinking about this matter, and hence may ultimately achieve some improvement in it.

Phosphate and phosphoric acid developments now appear to offer the greatest technical problems to the industry. The superabundance of nitrogen supply and the less-than-cost market price of nitrogen carriers have taken that element out of the spotlight of technical concern. The market characteristics of nitrogen, of course, remain important; they are discussed elsewhere in this issue of *Chem. & Met.* The problems of potash supply, also discussed on another page of this issue, are both simplified and complicated by the developments of 1931 and the still greater prospect of development in 1932 of an abundant domestic supply from the recent New Mexican mine.

Even the Muscle Shoals perennial now blossoms forth as a phosphate development, if one accepts the conclusions of the recent report by the joint commission of representatives of Alabama, Tennessee, and the federal government. This transfer of attention from nitrogen or power to phosphates does not, however, in any way lessen the seriousness of the Muscle Shoals threat for fertilizer or electrochemical interests. The change is rather to be viewed as a clever tactical move on the part of those who realized that they had come to the end of their rope if restricting themselves to power or nitrogen. Seemingly, therefore, in order to make Muscle Shoals still "an important issue" they have chosen to base it on the prospect of phosphoric acid manufacture in order to cheapen fertilizers and continue the "dedication to agriculture."

Superphosphate manufacture continues the basis of most of the fertilizer industry's technology. The surprisingly uniform rate of production from 1923 to 1929 has, of course, been materially lowered by the restriction of total fertilizer market. It is probable that 1930 represents the first year in about a decade in which actual tonnage of P_2O_5 contained in fertilizers used on the land of the United States decreased from the preceding year. Although there probably was a slight increase in percentage content of this plant food, the

Estimated Consumption of Plant Food in the United States

(Including Hawaii and Porto Rico)

Compiled for *Chem. & Met.* by The National Fertilizer Association

	1913	1919	1925	1926	1927	1928	1929	1930
PART A — NITROGEN (Short Tons of Nitrogen Contained)								
Chemical Sources:								
Nitrate of soda	55,000	67,000	110,000	78,000	70,000	99,000	107,000	98,500
Sulphate of ammonia	30,000	30,000	82,000	80,000	97,000	130,000	127,400	124,000
Calcium cyanamide	3,000	2,000	20,000	16,000	19,000	24,000	20,400	15,750
Ammonia	....	....	....	....	....	3,000	20,000	30,000
Calcium nitrate	....	....	1,360	2,360	3,200	4,000	5,300	5,640
Ammonium sulphate-nitrate	....	....	....	4,540	12,500	19,000	9,400	2,400
Urea and calurea	....	....	....	....	....	400	7,100	6,340
Ammonium phosphate (includes nitrophoska)	....	....	....	....	....	600	6,900	9,230
Total chemical	88,000	99,000	213,360	180,900	201,700	280,000	303,500	291,860
Natural Organics:								
Cottonseed meal (1)	50,000	31,500	22,000	26,000	28,000	16,000	12,100	13,500
Packing house byproducts (2)	29,000	18,300	12,100	10,300	9,300	8,300	8,200	8,100
Fish scrap and meal	17,500	19,100	4,200	3,850	3,500	3,150	3,020	2,800
Guano	9,600	2,640	1,560	1,040	2,080	2,020	3,260	3,600
Rough ammoniates (3)	19,000	18,500	18,000	18,600	18,900	19,900	20,100	20,100
Other nitrogenous materials (4)	....	6,800	6,900	5,270	5,090	7,800	4,870	8,290
Total natural organics	125,100	96,840	64,760	65,060	66,870	57,170	51,550	56,390
Total nitrogen	213,100	195,840	278,160	245,960	268,570	337,170	355,050	348,250
PART B — PHOSPHORIC ACID (Short Tons of P_2O_5 Contained)								
Superphosphate	488,000	676,000	700,000	703,000	673,000	750,000	753,000	763,000
Bone (all kinds)	35,000	40,700	24,000	21,000	20,000	19,000	18,000	18,000
Ammonium phosphate (5)	....	....	....	....	....	....	11,400	15,600
Miscellaneous organics	65,000	41,000	29,500	28,500	31,000	28,000	22,000	22,000
Total phosphoric acid	588,000	757,700	753,500	752,500	724,000	817,000	804,400	818,600
PART C — POTASH (Short Tons of K_2O Contained)								
Imports (6):								
Muriate	118,000	11,600	90,175	111,546	91,740	130,822	129,340	152,988
Sulphate	21,500	680	37,068	37,563	37,042	46,480	42,744	46,372
Manure salts	50,100	9,070	96,826	79,743	70,055	101,980	98,488	91,145
Kainit	64,600	7,180	25,596	25,463	14,418	14,987	10,630	15,705
Total imports	255,200	28,530	249,665	254,315	213,255	294,269	281,202	306,210
Domestic sales	....	45,730	25,800	25,060	49,500	60,370	57,540	56,610
Total potash	255,200	74,260	275,465	279,375	262,755	354,639	338,742	362,820

(1) Includes that used by farmers.
(2) Includes tankage, dried blood and hoof and horn meal.
(3) Includes processed tankage, activated sludge, and nitrogen content of wet base goods.
(4) Imported. Included with rough ammoniates in 1913.
(5) Includes P_2O_5 content of nitrophoska.
(6) Muriate estimated at 50 per cent K_2O, sulphate at 48 per cent, manure salt at 22.5 per cent and kainit at 12.5 per cent.

total tonnage of P_2O_5 certainly was somewhat less than in the preceding year. A decline in 1932 is inevitable, in conformity with the prospective decline in total tonnage.

Phosphoric acid manufacture continued during the past year on approximately the same basis as during the preceding year. No new commercial-scale blast-furnace or electric-furnace operations were reported. The rumored reopening of the blast-furnace plant of the Coronet Phosphate Co. under new ownership did not materialize. . Nor where any new enterprises of large scale reported elsewhere.

World-trade in phosphate rock very generally declined. Figures for the first eight or nine months of the year indicate imports in the major consuming countries of Europe at about 60 per cent of the preceding year's level. Exports from the North African producing countries of Tunisia and Morocco both declined correspondingly, to about 70 per cent and 55 per cent of the preceding year, respectively. Indications from all of Europe and from North Africa are that still further declines are in prospect for 1932. Exports from the United States in the first ten months of 1931 were 70 per cent of those in the corresponding period of the preceding year. This indicates that the United States' share in world trade at least did not decline.

Formal adoption by the Official Association of Agricultural Chemists of the new analytical procedure for testing phosphates has resulted in the adoption of this modified method of analysis very generally. By the opening of the active fertilizer shipping season it is expected that this procedure, giving full credit for all of the phosphate in ammoniated superphosphate, will be in general use. Thus the handicap suffered during the past two or three seasons by ammoniated products is removed.

Concentrated fertilizers did not gain in public esteem during the past year. Numerous eminent agronomists and certain commercial groups guided by their judgment now clearly indicate the abandonment of the theory that concentrated fertilizers made of pure chemicals are generally desirable. This conclusion appears to have been reached on three grounds.

In the first place, the difficulty of distributing the more concentrated fertilizers is a serious handicap in application. With concentrated chemicals used in fertilization, the damage to seed and to seedlings has proved a material factor. In the second place, because of the greater cost per ton of concentrated goods, there is distinct merchandising difficulty in persuading the agricultural people to purchase high-cost and high-concentration goods. In the third place, the minor elements for maintenance of soil fertility are now recognized as frequently of material importance. In order to maintain an adequate supply of lime and of magnesia, the use of mixed fertilizer containing gypsum, limestone, or dolomitic limestone is now believed by agronomists to be frequently of material importance. Hence, for purely agronomic reasons, this scientific group is tending to discourage the use of pure chemicals and to return to mixed fertilizers of moderate analysis, including in them generous quantities of the needed calcium and magnesium compounds.

In general this tendency is so strong that it appears fully able to offset the previously growing importance of chemicals for independent use in fertilizer practice. These chemicals are under the new tendency to be used rather as constituents of mixed goods of moderate analysis, perhaps averaging in the neighborhood of 20 per cent plant food in the total mixture.

Chilean Nitrate of Soda

Statistical information regarding the progress of nitrate of soda production for the past year has not been available. The British Sulphate of Ammonia Federation has just issued an estimate on world nitrogen production for the year ended June 30, 1931.

That British agency estimates that the production of Chilean nitrate was equal to 250,000 metric tons of contained nitrogen and that the world consumption of Chilean nitrate during the same period was 244,300 metric tons of contained nitrogen. These are equivalent approximately to a production of 1,700,000 short tons of commercial grade Chilean nitrate. And by inference one may assume that the visible world stocks of Chilean nitrate increased by approximately 35,000 metric tons and were, therefore, in the neighborhood of 2,400,000 metric tons on July 1, 1931.

The Chilean authorities have apparently not been willing to give out during the last year or two any figures on production, exports, or stocks. It is evident, however, that during the last half of the calendar year 1931 the consumption of nitrate still further dwindled and it is reasonable to assume that the stocks are today somewhere between 2,600,000 and 3,000,000 metric tons, probably nearer the upper figure named.

There was a material decline in shipments of Chilean nitrate of soda to the United States in 1930. Arrivals at American ports in 1930 were 567,894 tons, or a decline of almost 39 per cent from the 930,458 tons received in 1929. For the first eleven months of 1931, imports of nitrate of soda into this country reached a total of 532,584 tons, which was pretty much on a par with imports of 533,082 tons for the corresponding period of 1930.

More than 40 per cent of the value of the sales by manufacturing plants engaged primarily in making fertilizer are made to consumers, such as farmers, cooperative growers, other manufacturers, etc. Data collected for the Census of Distribution show that of the total sales by these plants in 1929, amounting to $240,697,000, 41.2 per cent, or $99,101,000, was sold in this way.

Sales to retailers amounted to 32.1 per cent, or $77,162,000 of the total sales. Other sales were as follows: to wholesalers, 15.7 per cent, or $37,848,000; and to manufacturers' own retail branches, 0.9 per cent, or $2,275,000.

Manufacturing plants sold 10.1 per cent, or $24,311,000 worth of goods, to their own wholesale branches. This report does not show the distribution of sales of these branches.

Of the above sales to dealers and consumers, $17,272,000 was made through manufacturers' agents, selling agents, brokers, or commission houses. Seventy manufacturing plants sold through such agents, 27 of them selling their entire output in this way.

The total of the sales as shown above is $8,186,000 greater than the value of products as reported by the industry. This difference is accounted for as follows: jobbing to the extent of $1,799,000 was reported by 10 plants; the net change in inventory amounted to $2,693,000; and differences unexplained by the manufacturers reporting, but which may also be sales from inventory, totaled $3,694,000.

A Census of Manufactures report giving preliminary statistics on production, wage earners, wages, etc., for this industry was issued by the Census Bureau in 1930. A final report, in which the statistics will be presented in greater detail, will be issued later.

The following statement, issued by the Director of the Census, gives for the United States the number of farms reporting expenditures for fertilizer (including commercial fertilizer, manure, marl, lime, and ground limestone) and the amount expended in 1929; and the number of farms reporting the purchase of commercial fertilizer and the quantity purchased in 1929.

	Farm Expenditures for Fertilizer (1)		Commercial Fertilizer Purchased	
Division or State	Number of Farms Reporting	Amount (Dollars)	Number of Farms Reporting	Quantity (Tons)
United States	2,324,092	271,065,703	2,239,545	7,535,022
New England	68,537	15,413,246	68,318	345,303
Middle Atlantic	224,819	30,202,356	206,325	798,433
East North Central	330,789	29,283,692	318,594	773,057
West North Central	67,978	4,471,581	56,418	106,332
South Atlantic	813,149	119,238,902	808,199	3,707,305
East South Central	530,274	40,095,966	529,175	1,185,827
West South Central	221,100	15,719,031	219,773	431,855
Mountain	5,818	635,169	3,824	10,272
Pacific	41,628	16,005,710	28,919	176,638

(1) Including commercial fertilizer, manure, marl, lime, and ground limestone.

New Bichromate Production

AMONG the important developments of the year in the market for sodium salts was the announcement in the latter part of the period that a new plant had been erected and had started production of bichromate of soda. This chemical had maintained a steady price position in recent years, but the increased competition quickly brought out selling pressure and prices gradually gave way from the 7c. per pound level which had prevailed to 5c. per pound as the closing price of the year. The open quotation was held above 5c. per pound, but on contract business involving large amounts producers were willing to accept the 5c. price.

With the exception of one producer who consumed a large part of his production, the output of bichromate for a long time had rested between two manufacturing companies with a combined output sufficient to take care of domestic requirements and leave a surplus for export. Increase of output, therefore, disturbed the equilibrium of the market and gave promise of unsettled conditions for some time to come.

Lower prices for chrome ore, soda ash, and other raw materials would have made it possible to reduce prices for bichromate of soda last year, but it is probable that sales schedules would not have been so drastically changed had not competition been increased by the threat of a new source of supply.

Producers of bichromate also have been in a position to benefit from the large demand which sprang up in the last few years for chromic acid. While production of the acid has not been confined to manufacturers of bichromates, the latter have been prominent in the new industry and have accounted for a large part of production.

From the time its production as a byproduct in the manufacture of muriatic acid was curtailed, salt cake has been an item of interest in the market. Last April, the Treasury Department announced that a request for an antidumping order against salt cake imported from Germany was not justified. This calls attention to the fact that in recent years salt cake has assumed an important place in our import trade. For the first eleven months of 1931, imports were officially reported at 134,624,865 lb., valued at $741,061. The first effect of the drop in domestic production was the creation of a shortage, which carried with it an inflation of prices. This may have directed attention of foreign producers to the fact that this country offered a market for this product. At any rate, import trade in salt cake took on larger volume with the cutting down of domestic supplies. It now appears as if foreign sellers have become intrenched in the domestic market and as they have undersold the domestic product, consumers have not been in favor of taking any action which would interfere with imports.

Incidentally, the reduction in byproduct cake production stimulated demand for the natural cake and, while figures for 1931 are not yet at hand, it is worthy of attention that shipments of natural sodium sulphate, including all grades, increased from 7,540 tons in 1929 to 30,100 tons in 1930.

Canada has developed rapidly as a consumer of salt cake and niter cake and has also made considerable effort to expand Canadian sources of supply. Because of increased buying on the part of Canada our export trade in these two chemicals has increased in volume. During the first eleven months of last year we exported 9,240,446 lb. of sodium sulphate and 25,875,321 lb. of sodium bisulphate.

Production of phosphates of soda has gained considerable headway in the last three years and new consuming outlets have been developed. The number of producers likewise increased and last year, with a recession in consumption, the market suffered from a superabundance of supplies, with a consequent weakening in values. At times the market was so weak that consumers could practically dictate their own prices. In the latter part of the year, stocks were more firmly held and the new year opened with the promise of a closer regulation of production and consumption and a greater adherence to quoted prices as a basis for sales.

Export trade in phosphate of soda has been on the upgrade with shipments of 5,631,956 lb. valued at $172,858 representing the total for the first eleven months of 1931.

First Quarter Forecast

The Atlantic State Shippers' Advisory Board, in a forecast of car requirements for the first quarter of 1932, estimates a 4.1 per cent in the movement of all commodities in comparison with that of the first quarter of 1931. An increase of 8.8 per cent, however, is indicated for the delivery of chemicals for the quarter.

Estimates for the movement of specified commodities include:

	Per Cent Increase	Per Cent Decrease
Chemicals	8.8	
Coke	5.0	
Fertilizer	....	15.2
Glass containers	....	5.0
Hides, leather, and tanning materials	....	5.0
Lime	....	21.5
Non-ferrous metals	....	13.0
Paints and varnishes	....	3.2
Paper and pulp	....	3.4
Petroleum	same	same
Salt	....	2.5
Textiles	1 to 50	

Quicksilver

IN 1926, only 22.5 per cent of the supply of quicksilver in this country was produced at home, imported material holding control of the market. Placing the import duty at the rate of $19 a flask, gave an impetus to domestic production, and from 1926 to date imports have been on a descending scale. In 1930, domestic output was reported at 25,200 flasks, which, although considerably under the total of 38,500 flasks for the preceding year, represented 85.2 per cent of the total supply, as imports amounted to only 3,725 flasks. Slowing up in the industries which are consumers of quicksilver was responsible for the decline in production in 1930, and a continuance of those conditions affected domestic production in 1931. As imports of quicksilver for the first eleven months of 1931 were only 27,054 lb., equivalent to 356 flasks of 76 lb., it is evident that domestic quicksilver was in almost absolute control of the market last year.

With foreign producers practically eliminated, factors in the domestic trade soon found that output was running ahead of consumption, and, although some mines were closed, the market was under pressure throughout 1931 because of the keen competition which followed attempts to reduce holdings.

In January the quotation was on a basis of $105 a flask. At the end of the year the quoted price had declined to $65 a flask. The decline in price started during 1930 and it was noted that the Spanish-Italian combination, Mercurio Europeo, did not attempt to meet the lower prices quoted by American producers.

In June, 1931, the weight of stocks in Europe made itself felt and Mercurio Europeo announced a reduction in price which would enable it to sell on the Atlantic seaboard at the rate of $101 a flask, duty paid. For two and one-half years prior to that, the foreign cartel had held the market unchanged at $125 a flask.

As it was felt that domestic producers could not compete if the market price dropped to $100 a flask, it was feared that the action of foreign sellers foretold the cessation of domestic production. The reverse was the case, however, and domestic producers not only met offers from abroad but waged a keen competition among themselves which kept prices on a downward trend throughout the last half of the year.

Industrial Alcohol Output Curtailed

ALCOHOL produced at industrial plants last years fell off in volume as compared with the total for the preceding year, but the decline was less severe than for 1930 in comparison with 1929. For the calendar year 1929, production was 206,662,000 proof gallons, and the total for 1930, 167,169,000 proof gallons showed a decline of slightly more than 19 per cent. Figures are not yet available for 1931, but for the first ten months, they showed an output of 123,449,000 proof gallons, which compared with 128,538,000 proof gallons for the corresponding period of 1930, or a decline of about 3.9 per cent. For the fiscal year ended June 30, production was officially reported at 191,859,334 proof gallons and 166,014,346 proof gallons for 1930 and 1931 respectively, or a loss of about 13.4 per cent for the latter year.

Taking the amounts of alcohol withdrawn for denaturation as representative of denatured alcohol production, the output for the first ten months of 1931 would be represented by 106,531,000 proof gallons, with 117,766,000 proof gallons for the comparable period of 1930, or a decline of 9.5 per cent for 1931 production.

For the fiscal year ended June 30, 1931, it is interesting to note that of the 49,117,783 proof gallons of alcohol completely denatured, only 7,588,299 proof gallons was produced by formula No. 1, which calls for the use of methanol as a denaturant, whereas 41,529,484 proof gallons was produced by formula No. 5, which specifies aldehol or alcotate as a denaturant. In the specially denatured group, first place from a volume standpoint was held by formula No. 2-B, with 8,942,425 proof gallons, for which benzol was the denaturing material. Next came formula No. 1, with methanol used to denature 7,593,947 proof gallons. Formula No. 18 accounted for an output of 6,054,997 proof gallons, with vinegar used in the admixture. Next in line was formula No. 23-A, with an output of 3,237,581 proof gallons, of which acetone was the denaturant. Sulphuric ether also was extensively used for denaturing purposes in different formulas.

In reporting for the last fiscal year, the Commissioner of Industrial Alcohol stated that the manufacture of synthetic ethyl alcohol from ethylene gas had been firmly established on a commercial basis and is now a recognized source of industrial alcohol on a large scale. Between six and seven million gallons was produced during the last fiscal year.

Production of industrial alcohol since the beginning of 1928 has been controlled by fixing a total for the year and by allocating to each plant a fixed quota with the proviso that, unless consuming demand should make it necessary, only 40 per cent of the total quota may be produced in the first six months of the calendar year.

In some foreign countries the compulsory use of alcohol in gasoline mixtures for motor fuel is under discussion. The National Alcohol Council of Poland has recommended such a measure to apply July 1. From 6 per cent to 12 per cent of alcohol is proposed for the mixture. A similar movement is under way in the Argentine with 30 per cent alcohol proposed for the mixture. The primary purpose of these proposals is to help domestic agriculture. While this movement has not spread to this country, the effect of such a regulation on production and consumption of alcohol may be surmised if it were adopted as a farm relief measure.

Production of industrial alcohol for the present year has been allotted on a basis of 80,000,000 wine gallons, the same as for the preceding year, although in 1931 none of the alcohol producers operated up to full quota. The allotments of the different producers have not been made public, but it is reported that the largest producing company has a quota of 34 per cent and that synthetic production has been assigned a place corresponding to that held last year.

Trading in alcohol in the last year was featured by sharp competition which brought prices to an unusually low level. Due to falling off in antifreeze trade, general industrial depression, and more successful control to prevent diversion, stocks had accumulated in the early part of the year and the weight of offerings stimulated sales campaigns to a point where production costs were disregarded. With general economic adjustments within the industry and with raw materials available at attractive prices, producers entered the new year with an encouraging outlook, especially as sales prices for deliveries over the first quarter of the year had been marked up considerably above the previously existing figures. There also was evidence that competition, however keenly it might develop, would not resort to price cutting. The new price schedule as established late in the year named 27½c. a gallon as a base price for pure alcohol in tanks at producing points. The cost of packaging and denaturing is added to the base price and freight charges are added to delivered cost.

Products Manufactured With Specially Denatured Alcohol

Year ended June 30, 1931

Products	Denatured Alcohol Used Wine Gal.
Antiseptic solutions	895,182
Barber-supply preparations	60,594
Bathing alcohol	1,402,238
Bay rum	198,384
Candy glaze	38,908
Cements	38,378
Chemicals and food products	7,508,027
Dentifrices and tooth paste	40,956
Deodorants and disinfectants	133,631
Drugs and medicines	3,408,890
Dyes and intermediates	562,110
Electrical supplies	15,108
Ether	1,271,894
Ethyl acetate	3,620,889
Ethylene	550,588
Fungicides and insecticides	19,819
Hair tonics	1,001,048
Hats	20,458
Hydraulic brake fluid	149,408
Lacquers and solvents	9,055,312
Leather and leather solutions	900,618
Liniments and lotions	949,745
Nitrocellulose	7,580,882
Perfumes	314,319
Petroleum oils	1,924,499
Photographic supplies	1,021,385
Polishes and cleansers	74,151
Pyroxylin and plastics	5,322,857
Rayon	2,073,633
Resin and synthetic resin	772,529
Shellacs, varnishes, paints	3,874,661
Soaps	175,593
Solvents	1,420,347
Tincture of iodine	67,546
Tobacco and solutions	1,289,765
Toilet preparations	898,007
Toilet waters	906,915
Vinegar	7,293,535
Miscellaneous	221,629
Total	67,074,438

Materials Used in Alcohol Production

Year Ended June 30, 1931

Corn, lb	127,156,539
Rye, lb	342,122,187
Malt and sprouts, lb	18,944,324
Wheat, lb	1,455,980
Potatoes, lb	59,876
Figs, lb	51,095
Candy, lb	6,622
Pumpkin seed, lb	62
Chemicals, lb	30,226,037
Molasses, gal	186,248,157
Liquids containing one-half of 1 per cent of alcohol, gal	18,378,443
Mixed sulphate, gal	10,072,400
Pineapple juice, gal	5,767,500
Wine, gal	846,177
Pomace, gal	76,622
Syrup, gal	1,127

Alcohol Produced at Industrial Plants and Withdrawals for Denaturing

Fiscal Year	Alcoho Produced, Proof Gal.	Ethyl Alcohol Withdrawn for Denaturation, Proof Gal.	Denatured Alcohol Produced: Completely, Wine Gal.	Denatured Alcohol Produced: Special Wine Gal.	Denatured Alcohol Produced: Total, Wine Gal.
1922	79,906,101.50	59,549,919.6	16,193,523.60	17,152,224.31	33,345,747.91
1923	122,402,849.81	105,819,404.9	27,128,229.54	30,436,913.14	57,565,142.68
1924	135,897,725.83	121,576,196.1	34,602,003.72	33,085,292.04	67,687,295.76
1925	166,165,517.81	148,970,220.9	46,983,969.88	34,824,303.28	81,808,273.16
1926	202,271,670.32	191,670,107.2	65,881,442.43	39,494,443.80	105,375,886.23
1927	184,323,016.97	170,633,436.7	56,093,748.16	39,354,928.48	95,448,676.64
1928	169,149,904.83	159,689,378.2	46,966,601.28	45,451,424.28	92,418,025.56
1929	200,832,051.08	182,778,966.1	52,405,451.92	54,555,006.15	106,960,458.07
1930	191,859,342.42	181,601,420.3	58,141,740.88	47,645,796.84	105,787,537.72
1931	166,014,346.15	149,303,438.5	49,136,200.64	37,172,740.71	86,308,941.35

Methanol Stocks Increased

PRODUCTION of crude methanol by the distillation of wood again was on a declining scale in the last year. At the beginning of the year a change in the requirements of denaturing materials for completely denatured alcohol went into effect. This change deprived crude methanol of its largest single market and accounts in large measure for the slower rate of productive activities during the year. The curtailment of consuming outlets not only had the effect of checking production but also of reducing the number of operating plants.

Refined methanol produced in the wood distillation industry reported a still higher rate of decline than that registered for the crude product. The transition in use of refined methanol from the wood distillation product to synthetic offerings was the outstanding development in this market in 1930, and this situation was even more emphasized in 1931.

The output of synthetic methanol, while falling short of plant capacities last year and, in fact, showing no gain over the total produced in 1930, nevertheless was the dominating factor in the market. Production and other statistics for crude and refined methanol for 1930 and for the first eleven months of 1931 will be found in the accompanying table.

Consumption of Methanol

Apparent consumption of crude methanol, as indicated by shipments, with adjustments for differences in stocks at the beginning and the close of the year, amounted to approximately 5,598,000 gal. in 1930 and 3,050,000 gal. in 1931, or a loss of more than 45 per cent for the latter year. Apparent consumption of refined methanol made by wood distillation was about 5,338,000 gal. in 1930 and 1,740,000 gal. in 1931, or a loss of 67 per cent for the latter year.

According to the same method of calculation, consumption of synthetic methanol in 1930 was about 6,500,000 gal., which compares with 5,500,000 gal. for 1931. Out of a total consumption of 11,838,000 gal. of synthetic methanol, wood distillation and synthetic, in 1930, the synthetic product accounted for nearly 55 per cent. In 1931, consumption of refined methanol was approximately 7,140,000 gal., with synthetic methanol taking care of more than 75 per cent of this total.

The large increase in stocks of synthetic methanol undoubtedly served to place a check upon production and likewise bore witness to the fact that consuming demand had not come up to expectations. The decline in prices in 1930 placed methanol in a position to compete as an anti-freeze for automobile radiators. It was estimated that about 4,000,000 gal. would be used for anti-freeze purposes in the 1930-1931 season, but, owing to objections raised because of the alleged toxicity of methanol, this total was not realized.

Butyl Alcohol

THE number of domestic producers of butyl alcohol was increased to four in the last year. The latest producer to enter the field is making a synthetic product and the first shipment of the new product was made in the closing days of the year. This company is reported to have an annual plant capacity of 15,000,000 lb. of butyl alcohol, part of which will be sold as such and part converted into butyl acetate, butyl aldehyde, and other butyl compounds.

On Dec. 29 an opinion was filed in the U. S. District Court at Wilmington, Del., upholding the validity of the Charles Weizman patent for the production of butyl alcohol and acetone. This was the outcome of an infringement suit brought against a producer of butyl alcohol and acetone. The court decision also issued an injunction enjoining the defendant company from further infringement and ordered it to file an accounting of profits derived from past infringement.

The growth of the solvents industry in recent years has been paralleled in the case of butyl alcohol. Official figures for production of butyl alcohol are lacking, but estimates have placed production in 1928 at 49,860,000 lb., with an increase to 67,500,000 lb. in 1929. Some estimates have credited 1929 production in excess of 100,000,000 lb., but this total appears to represent too large an increase over the preceding year. The estimate for 1928 appears to be in line, as a little more than 8,000,000 bu. of corn was utilized and this would represent a total of more than 48,000,000 lb. of butyl alcohol and upward of 24,000,000 lb. of acetone.

Lacquer Solvents Down

Official compilations show that production of lacquer solvents in 1930 declined about 15 per cent. With butyl and amyl alcohols, butyl and amyl acetates forming the main part of this group, it is fair to assume that butyl alcohol production for that year declined somewhat to that extent.

Production of butyl alcohol last year was on a fairly large scale in the first half of the year, but demand did not keep pace with the supply and some plants were closed in the last half of the year in order to reduce stocks that had accumulated at producing points.

Prices for butyl alcohol declined from 15¾c. per pound in tank cars at the beginning of the year to a closing figure of 14.3c. per pound. Lower production costs were cited as bringing about the downward revision, but competition among sellers was not without influence.

Production of Specified Synthetic Organic Chemicals in 1930

	Lb.
Total production	609,363,028
Amyl acetate	4,416,940
Butyl acetate	35,455,752
Carbon tetrachloride	34,298,036
Chloroform	2,460,969
Ethyl acetate	69,669,995
Ethyl ether	8,698,583
Formaldehyde	40,763,470
Gallic acid	380,034
Hexamethylenetetramine	1,871,690
Methanol, synthetic	48,930,545
Pyrogallol	143,408

Production, Shipments, and Stocks of Crude and Refined Methanol

	Refined Methanol						Crude Methanol			
	From Wood Distillation			Synthetic				Stocks, End of Month		
1931	Production, Gal.	Shipments, Gal.	Stocks, End of Month, Gal.	Production, Gal.	Shipments, Gal.	Stocks, End of Month, Gal.	Production, Gal.	Total, Gal.	At Crude Plants, Gal.	At Refineries and in Transit, Gal.
January	306,373	167,309	444,119	769,553	510,703	1,354,890	522,656	392,060	302,320	89,740
February	223,144	221,279	445,984	662,735	402,650	1,614,975	465,728	517,377	395,855	121,522
March	253,494	199,500	499,978	732,233	490,795	1,856,413	483,222	520,727	415,489	105,238
April	211,073	141,801	569,250	785,164	397,901	2,243,676	322,049	557,041	520,865	36,176
May	118,052	257,707	429,595	784,108	344,229	2,683,555	247,808	624,399	494,192	130,207
June	107,331	110,454	426,472	654,472	429,361	2,908,666	182,273	624,543	526,543	98,000
July	91,696	122,846	395,322	437,805	283,866	3,062,605	154,473	609,583	452,489	157,094
August	65,311	129,822	330,811	315,940	414,975	2,963,570	113,892	541,307	395,907	145,400
September	56,519	98,431	288,899	663,216	699,380	2,927,406	133,507	485,094	378,991	106,103
October	56,474	105,060	240,313	510,432	1,187,529	2,250,309	183,851	583,975	466,975	117,000
November	87,486	89,704	238,095	364,118	599,061	2,015,366	206,416	529,425	410,439	118,986
Total (11 months)	1,576,953	1,643,913	....	6,679,776	5,760,450	....	3,015,875	....	....	....

Vegetable Oils at Low Prices

IMPORTS of vegetable oils declined about 14 per cent in volume last year and, based on the latest available statistics, domestic production fell off to about the same extent. There was a decline, however, of about 300,000,000 lb. in stocks, and the figures for factory consumption for the first three quarters of last year show a decline of but little over 11 per cent, as compared with the corresponding period of last year. Fish oils were available in quantities larger than usual and the increased use of fish oils cut down consuming demand for vegetable oils. Consumption of fish oils in the first three quarters of 1931 amounted to 151,100,000 lb., compared with 124,220,000 lb. consumed in the like period of 1930. Animal fats, also, because of the low prices at which they sold, gave greater competition than usual in the fields where they compete with vegetable oils. Consumption of inedible tallow in the first nine months of last year reached a total of 420,000,000 lb., in comparison with 392,490,000 lb. in the corresponding period of 1930.

That consumption of edible oils also was on a smaller scale is made evident by further reference to the figures for the first nine months of the year. During that period the output of refined vegetable oils was 955,447,000 lb. in 1931 and 1,125,690,000 lb. in 1930.

The most important development of the year, however, was the low level of prices which was reached by the majority of offerings. Even pre-War levels were high in comparison with the quotations put out on such oils as cottonseed, corn, peanut, soya bean, palm, and coconut. Oils of foreign origin, notably those produced in the Far East, failed to find their customary outlets in European markets, and as a result greater pressure was used to increase shipments to this country. This pressure, coming at a time when the supply of domestic oils and fats was large and consuming demand was relatively light, had a depressing effect on the entire market. The decline in linseed oil prices was less pronounced than that for the general list, as that oil was more free from the competitive influences which depressed other oils.

As a development of the last two years, it is noted that domestic production of sesame oil and sunflower seed oil has become important enough to be included in the official census statistics. Domestic production of soya bean oil also has made considerable progress, although unfavorable financial returns brought about a curtailment in original production schedules.

Factors in Soap Industry

IN SOME respects soap manufacture is an ideal chemical industry: its raw materials, except a small percentage of packaging, are principally chemical, and its markets are based on a universal necessity. As a result the general business recession was slow making itself felt; in fact, had it been arrested sooner, the soap industry probably would not have felt it at all. That this is not now true, even in this favorable case, may add some interest to a brief consideration of the industry's position.

The components of the factory price of an average domestic soap (imagining a composite of laundry, toilet, shaving, chips, etc.) were given in the tabulation on page 5. Reducing these figures further to a consumer's price (1929 basis), the percentage components become: labor, 4.5; supervision, 2.7; chemical raw materials, 33.3; packaging, 8.5; power, 1.0; fixed charges and profit, 12; marketing, 28.2; transportation and distribution, 9.8. Of the last figure, freight constitutes almost half; that is, 4.5 per cent of the total consumer's price. Glycerine resale is included with profit and fixed charges. Activities other than soap making have been segregated.

Using the same average soap again, it is possible to split up its weight into the constituent raw materials:

Fat and oil	45.7	Bleaching earths	0.4
Alkalis	27.5	Mineral acid	0.5
Salt	3.2	Rosin	3.6
Lime	9.7	Essential oils	0.2
Silica sand, ash	9.2	Total	100.00

On an equivalent basis, packaging materials would constitute another 2.7 per cent by weight—which is of interest for distribution costs. The estimated actual consumption of the principal materials above are shown on page 5 for 1929 and on page 40 (alkalis only) for 1931.

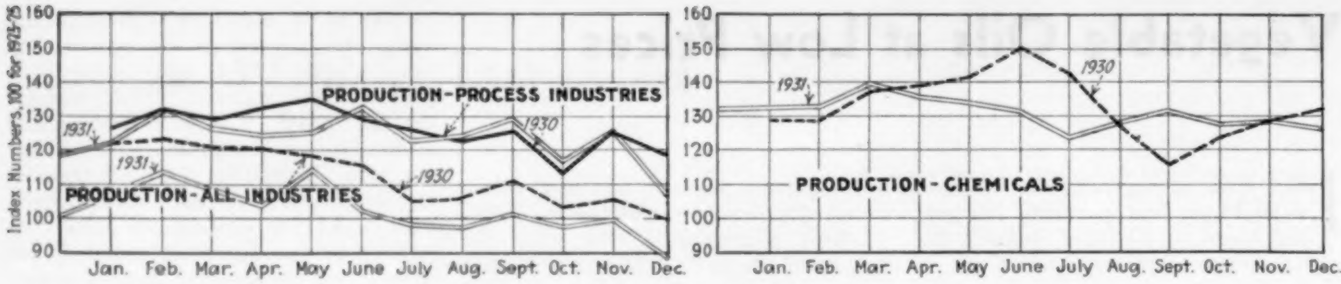
Judging from raw material consumption in 1931, soap production declined from a total of 1,650,000 tons in 1929 to about 1,550,000 tons in 1930 and about 1,500,000 tons in 1931; that is, the principal decline occurred in 1930 and the past year has receded only 2.5 per cent in addition. However, when the production is split into laundry soaps, comprising almost 70 per cent of the total; and toilet, shaving, powdered, and other kinds, the remainder, it is found that on a sales basis the latter group represents about half the normal profit of the industry (about $21,000,000 in 1931). The situation that has developed is not only that laundry sales have dropped because of idleness of business but that the smaller, highly profitable, group has gradually suffered pressure from the small consumer, who is buying the cheapest soap available. The result has been fairly sustained poundage sale, but a greatly reduced dollar sale and margin.

Factory and Warehouse Stocks of Vegetable Oils

	Jan. 1, 1931 Lb	Sept. 30, 1931 Lb.
Cottonseed, crude	114,248,422	69,744,520
Cottonseed, refined	428,609,270	173,944,857
Peanut, crude	7,888,443	9,991,349
Peanut, refined	1,857,630	3,166,493
Coconut, crude	164,205,940	201,036,367
Coconut, refined	22,352,232	17,515,783
Corn, crude	7,882,274	10,639,449
Corn, refined	8,881,799	8,769,182
Soya bean, crude	12,282,259	11,375,056
Soya bean, refined	2,665,678	4,349,265
Olive, edible	8,354,428	2,839,965
Olive, inedible	1,779,873	1,576,479
Olive foots	29,249,433	12,638,344
Palm-kernel, crude	15,234,364	10,862,254
Palm-kernel, refined	2,055,156	2,013,795
Rapeseed	5,370,682	4,204,232
Linseed	113,594,170	107,507,923
China wood	49,599,494	38,293,934
Castor	8,378,763	9,534,297
Palm	92,301,979	75,082,768
Sesame	....	14,185,287
Sunflower	....	2,704,131
All other	7,129,245	7,882,659
Totals	1,103,921,534	799,858,489

Factory Production and Consumption of Vegetable Oils

	Production		Consumption	
	Jan.-Sept., 1931 Lb.	Jan.-Sept., 1930 Lb.	Jan.-Sept., 1931 Lb.	Jan.-Sept., 1930 Lb.
Cottonseed, crude	651,605,175	892,320,545	700,164,054	909,094,994
Cottonseed, refined	633,541,836	820,476,430	751,516,962	910,861,368
Peanut, crude	10,409,835	21,275,715	10,107,378	10,393,121
Peanut, refined	8,757,997	7,688,710	9,162,496	7,197,579
Coconut, crude	234,732,313	254,349,353	415,112,923	477,960,715
Coconut, refined	202,300,980	211,345,692	232,324,029	224,493,186
Corn, crude	82,922,345	84,737,098	86,097,866	92,465,835
Corn, refined	73,799,310	71,117,851	19,410,993	11,011,021
Soya bean, crude	28,473,146	7,360,382	27,752,760	13,406,871
Soya bean, refined	18,591,775	4,261,624	12,610,879	6,893,609
Olive, edible	1,509,164	808,995	1,341,306	1,935,427
Olive, inedible	5,250	....	5,966,076	4,972,310
Olive, foots	....	....	31,100,602	30,037,234
Palm-kernel, crude	13,592,465	379,403	42,977,721	38,990,283
Palm-kernel, refined	18,455,813	10,799,549	18,319,978	10,693,068
Rapeseed	....	....	6,737,204	8,897,795
Linseed	390,256,792	385,069,473	240,139,810	280,236,578
China wood	....	....	65,646,601	69,657,152
Castor	38,029,880	36,819,071	13,505,852	14,610,812
Palm	....	....	191,568,636	164,939,145
Sesame	54,253,680	....	43,203,951	....
Sunflower	....	....	17,802,282	....
All other	857,827	14,477,821	4,297,878	38,151,772
Totals	2,462,095,583	2,823,227,712	2,946,868,257	3,326,899,875



Based on electrical power consumption, data supplied by Electrical World —

Chem. & Met.'s Indexes of Production

Low Naval Stores Exports

OVER a period of years the export trade has offered one of the largest outlets for naval stores. For the first ten months of 1931 export shipments of gum rosin amounted to 767,266 bbl., compared with shipments of 909,138 bbl. in the like period of 1930. During the same periods exports of wood rosin were 124,596 bbl. and 165,430 bbl. for 1931 and 1930 respectively. Hence total outward shipments for the ten-month period were 891,862 bbl. in 1931 and 1,074,568 bbl. in 1930. This represents a falling off of approximately 17 per cent and, as domestic buying had progressed along restricted lines, it is evident that the rosin branch of the naval stores industry was very decidedly affected by an abnormal drop in consumptive requirements.

Export trade in gum spirits of turpentine for the first ten months of last year reached a total of 10,057,761 gal., in comparison with 11,780,579 gal. in the first ten months of 1930. During the same months exports of wood turpentine were 625,194 gal. in 1931 and 724,132 gal. in 1930. This gives a total export trade in turpentine of 10,682,955 gal. for 1931 and 12,504,711 gal. for 1930, or a decline of about 15½ per cent for last year, which may be further increased when the figures for the twelve months become available.

Receipts of gum rosin and gum turpentine at southern ports are enumerated in the accompanying table and statistics also are included for production of wood turpentine and wood rosin. From the totals as given for the first ten months of the year, it will be seen that gum rosin receipts for the 1931 period were almost 11 per cent below those for the preceding year. Gum turpentine was shipped from producing points at the rate of more than 13 per cent below the movement of 1930. The concerted move of producers of wood rosin and wood turpentine at Southern shipping points the fact that the rosin product registered a drop of more than 27 per cent and the supply of wood turpentine was reduced by about 30 per cent from the 1930 total.

Increase in Stocks

Despite the apparent decline in production and the actual reduction in shipments from interior points to distributing markets, stocks of gum rosin increased in volume last year. At the close of January, 1930, stocks of gum turpentine at southern shipping points were reported at 58,485 bbl. This total had increased to 84,911 bbl. by the end of 1930 and at the close of October, 1931, the visible supply had mounted to 120,953 bbl. A similar development was found in the case of gum rosin. Stocks at the close of January, 1930, were 221,568 bbl.; at the close of December, 1930, 372,090 bbl.; and at the end of October, 1931, they had risen to 465,466 bbl.

On the other hand, trade in wood rosin and wood turpentine was better regulated and production during 1931 was governed so as to bring about a reduction in unsold stocks. At the beginning of January, stocks of wood turpentine stood at 15,799 bbl., and by the close of October they had been brought down to 5,231 bbl. Stocks of wood rosin at the beginning of the year were 122,318 bbl., and the figures on Oct. 31 were 101,537 bbl.

Prices for turpentine and rosin during the year reflected the preponderance of supply over demand. The low levels which prices reached would require a turning back for many years before their counterparts could be found. In the latter part of the year the market showed signs of a recovery, with a reduction in selling pressure.

In October, it was announced that the newly formed U. S. Timber Conservation Board would undertake a study of the naval stores industry in the course of its work. The naval stores industry was invited to cooperate and the various interests drew up a plan for carrying on the work. It is proposed to make a complete study of the economic phases which have a bearing on the present and future prosperity of the industry.

	Receipts at Southern Ports				Production			
	Gum Rosin		Gum Turpentine		Wood Rosin		Wood Turpentine	
	1931 Bbl.	1930 Bbl.	1931 Bbl.	1930 Bbl.	1931 Bbl.	1930 Bbl.	1931 Bbl.	1930 Bbl.
January	41,345	50,791	7,228	10,237	24,488	40,954	4,757	7,510
February	27,322	30,605	5,354	5,075	32,322	39,615	5,634	7,478
March	38,977	40,401	9,511	9,779	33,544	44,964	5,740	8,129
April	88,741	86,873	26,102	27,999	35,585	43,919	6,344	8,303
May	120,819	150,386	37,026	48,803	33,593	40,933	5,996	7,454
June	165,500	149,880	52,345	46,711	34,747	40,049	5,675	6,774
July	156,810	178,876	53,459	55,822	28,495	39,929	4,370	6,406
August	129,018	151,269	37,112	46,521	17,074	37,349	2,607	6,125
September	116,632	140,090	28,995	42,872	25,058	38,293	3,797	6,573
October	101,157	127,621	30,849	38,500	26,102	34,818	3,922	5,817
Totals	986,321	1,106,792	287,981	332,319	291,018	400,823	48,842	70,565

New Government Index

THE Bureau of Labor Statistics announces that beginning this month it will begin the publication of a revised wholesale price index, to be issued weekly as well as monthly. The new wholesale price index carries 784 price entries, instead of 550, as before. For most part the additional items are the fully manufactured commodities, or the so-called "consumers' goods." The new index continues the average for the year 1926 as its price base and all additional commodities have been priced back to that date.

The price material for the weekly index will be obtained from such published sources as are available and from direct weekly price quotations to the Bureau of Labor Statistics from manufacturers. The weekly price index will be computed and released for publication each week in the month. The monthly index will be computed separately as heretofore but on the larger number of commodities. It will not be an average of the weekly indexes, owing to the varying number of week endings in the month.

Chemical Values Resist Declines

IN A PERIOD when commodity prices were on a descending plane it was inevitable that values for chemical products should be influenced to some extent by the general trend. A comparison of different price indexes reveals that the downward movement of prices last year was less pronounced in the case of chemicals than it was in many other industries. The all-commodity index of the Bureau of Labor shows a monthly average of 96.5 for 1929, 86.3 for 1930, and 71.3 for 1931, or a drop of 10.2 per cent for 1930 and of 15 per cent for 1931. *Chem. & Met.'s* weighted index numbers for 1929 report a monthly average of 100.10 with 95.78 and 87.61 representing the monthly averages for 1930 and 1931, respectively. Hence chemical prices in 1931 declined 8.17 per cent, compared with a drop of 15 per cent for all commodities, and in the last two years, chemical prices fell off 12.49 per cent, compared with a fall of 25.2 per cent in all commodities. The fact that many chemical products held an unchanged price course throughout last year offers further proof of the resistance with which the chemical market opposed the general price tendency.

Any consideration of price developments for chemicals in the last year must take cognizance of the price-cutting competition which arose among producers of alkalis in writing contracts for delivery over 1931. This competition began in the latter part of 1930 and was continued in the early part of 1931 until practically all consumers had covered their requirements for the year at prices far below the levels that had previously ruled.

Producers of industrial alcohol staged a keen battle for business in the early part of the year, and in the intensity of the struggle, production costs were disregarded and sales were made at levels which made profits impossible.

In competing for 1932 contracts neither alcohol nor alkali manufacturers resorted to price-cutting tactics and the preceding price wars appear to have had the salutary effect of convincing chemical manufacturers that distribution of products gained at the sacrifice of values is not worth while.

The ten-year trend of prices for chemicals and for vegetable oils and fats, as measured by the weighted index numbers of *Chem. & Met.* is shown as follows, the figures representing the yearly averages of the monthly indexes:

	Chemicals	Vegetable Oils and Fats
1922	113.07	95.15
1923	116.91	103.43
1924	103.88	109.31
1925	104.41	117.12
1926	104.42	112.98
1927	100.00	100.00
1928	99.51	96.43
1929	100.10	97.55
1930	95.78	86.62
1931	87.61	61.90

As prices for raw materials were subject to the same influences that depressed values for finished products, fluctuations in many chemical selections were merely readjustments to make sales quotations conform to lower production costs. This condition was especially illustrated by the position of metal salts, which changed frequently because of changes in the metal markets, such changes having little or no effect on the profit margins of chemical manufacturers. Zinc oxide offered an exception to the fluctuating trend of prices for metal salts, as it held an unchanged position over the year. Corroders made no change in the price for white lead throughout the year up to December 28 when a sharp reduction was announced. This action is said to have been taken in order to give dealers the benefit of lower inventories, as the price had been guaranteed against decline to the end of the year. In other words, corroders voluntarily assumed to rebate dealers on all stocks of white lead carried over into the new year.

Another factor bearing upon the price position of chemicals was found in the disturbance of the balance between supply and demand by the introduction of new producers in the market. Bichromate of soda, which had held a steady price course in recent years, was lowered in price as soon as announcement was made that a new plant had entered production in Ohio. Synthetic production of butyl alcohol placed a new factor in the market for that product with sales schedules promptly revised downwards. Calcium chloride, which long had been featured by its steady price position, suffered a drastic cut coincident with the activities of a new producer to obtain contracts for 1932 delivery.

Foreign competition loomed up in a more important way in the latter part of the year as a result of the drop in foreign exchange and may figure even more prominently in the coming year.

Vegetable oils and fats declined in price during the year to a much greater extent than did chemicals. These products are influenced to a large extent by conditions in world markets and by the interchangeability of the products.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**85.77**
Last month	85.94
January, 1931	89.68
January, 1930	93.17

Higher prices were effective for alcohol, ethyl acetate, and turpentine but they were more than offset by declines in prices for white lead, the lead oxides, and bichromates. Hence the weighted number for the month moved downward.

Chem. & Met. Weighted Index of Prices for Oil and Fats

Base = 100 for 1927

This month	**47.33**
Last month	49.40
January, 1931	70.65
January, 1930	72.69

Crude cottonseed, corn, and peanut oils were lower in the last month. Tallow also was offered at fractionally lower levels and the price tone throughout was easy. Linseed oil closed above the preceding figure but was not firm.

Volume 39—*Chemical & Metallurgical Engineering*—Number 1

This magazine, *Chemical & Metallurgical Engineering*, is the successor to *Metallurgical & Chemical Engineering*, which in turn, was a consolidation of *Electrochemical & Metallurgical Industry* and *Iron & Steel Magazine*, effected in July, 1906.

The magazine was originally founded as *Electrochemical Industry*, in September, 1902, and was published monthly under the editorial direction of Dr. E. F. Roeber. It continued under that title until January, 1905, when it was changed to *Electrochemical & Metallurgical Industry*. In July, 1906, the consolidation was made with *Iron & Steel Magazine*, which had been founded eight years previously by Dr. Albert Sauveur. In January, 1910, the title was changed to *Metallurgical & Chemical Engineering*, and semi-monthly publication was begun Sept. 1, 1915. On July 1, 1918, the present title was assumed and weekly publication was begun Oct. 1, 1919. Monthly publication was resumed in March, 1925.

Dr. E. F. Roeber was editor of the paper from the time it was founded until his death on Oct. 17, 1927. After a brief interim he was succeeded by H. C. Parmelee. Ten years later, Nov. 1, 1928, Mr. Parmelee was made editorial director of the McGraw-Hill Publishing Company and was succeeded in the editorship of *Chemical & Metallurgical Engineering* by Sidney D. Kirkpatrick.

The editorial staff of the magazine comprises: S. D. Kirkpatrick, editor; H. M. Batters, market editor; James A. Lee, T. R. Olive, R. S. McBride, Paul D. V. Manning, and Richard Koch, assistant editors.

[Published each year as a matter of record.]

Current Prices in the New York Market

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Jan. 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.10 -$0.11	$0.10 -$0.11	$0.10.-$0.11
Acid, acetic, 28%, bbl., cwt	2.40 - 2.65	2.50 - 2.75	2.60 - 2.85
Glacial 99%, tanks	8.10	8.10 -	8.98 -
drs	8.35 - 8.60	8.35 - 8.60	9.23 - 9.48
U. S. P. reagent, c'bys	8.85 - 9.10	8.85 - 9.10	9.73 - 9.98
Boric, bbl., lb	.06¾- .07	.06¾- .07	.06¾- .07
Citric, kegs, lb	.33½- .35	.35 - .36	.40 - .41
Formic, bbl., lb	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Muriatic 18° tanks. cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb	.23 - .35	.23 - .35	.25 - .35
Tartaric, powd., bbl., lb	.25½- .26	.26½- .27½	.31 - .33
Tungstic, bbl., lb	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.33 -	2.33 -	2.63 - 2.71
Alcohol, Butyl, tanks, lb		.143-	.15½-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb	.203-	.203-	.236-
Denatured, 188 proof			
No. 1 special dr., gal	.34½-	.28 -	.39 -
No. 5, 188 proof, dr., gal	.35½-	.28 -	.39 -
Alum, ammonia, lump, bbl., lb	.03 - .04	.03½- .04	.03½- .04
Chrome, bbl., lb	.04½- .05	.04½- .05	.05 - .05½
Potash, lump, bbl., lb	.03 - .04	.03½- .04	.03 - .03½
Aluminum sulphate, com., bags, cwt	1.25 - 1.40	1.25 - 1.40	1.40 - 1.45
Iron free, bg., cwt	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02¾- .03	.02¾- .03	.03 - .04
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15½- .15½	.15½- .15½	.15½-
tanks, lb	.05½-	.05½-	.05½-
Ammonium carbonate, powd. tech., casks, lb	.10½- .11	.10½- .11	.10½- .11
Sulphate, wks., cwt	1.10 -	1.10 -	1.70 -
Amylacetate tech., tanks, lb., gal.	.16 -	.16½-	.222-
Antimony Oxide, bbl., lb	.06½- .08	.08 - .09	.08½- .10
Arsenic, white, powd., bbl., lb	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	58.00 -60.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb	.03¾- .04	.03¾- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums, cwt	1.75 - 2.00	1.75 - 2.00	2.00 - 2.10
Borax, grain, bags, ton	50.00 -57.00	50.00 -57.00	50.00 -57.00
Bromine, cs., lb	.36 - .38	.36 - .38	.45 - .47
Calcium acetate, bags	2.00 -	2.00 -	2.00 -
Arsenate, dr., lb	.06 - .07	.06 - .07	.07 - .08
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton	18.00 -	18.00 -	20.00 -
flake, dr., wks., ton	21.00 -	21.00 -	22.75 -
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.01¾-	.01¾-	.02 -
Cylinders	.04 - .06	.04 - .06	.04 - .06
Cobalt oxide, cans, lb	1.35 - 1.45	1.35 - 1.45	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton.	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb	.07 - .16	.07 - .16	.08½- .18
Cyanide, tech., bbl., lb	.39 - .44	.39 - .44	.41 - .46
Sulphate, bbl., cwt	3.10 - 3.25	3.10 - 3.25	4.00 - 4.25
Cream of tartar, bbl., lb	.20½- .22	.20½- .22	.24½- .26
Diethylene glycol, dr., lb	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb	.10 -	.06½-	.088-
Formaldehyde, 40%, bbl., lb	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb	.10 - .15	.10 - .12	.10 - .12
Fusel oil, crude, drums, gal	1.10 - 1.20	1.10 - 1.20	1.30 - 1.40
Refined, dr., gal	1.80 - 1.90	1.80 - 1.90	1.90 - 2.00
Glaubers salt, bags, cwt	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.11¼- .11¾	.11½- .12	.12½- .13
Lead:			
White, basic carbonate, dry casks, lb	.06½-	.07¼-	.07¼-
White, basic sulphate, sck., lb.	.06 -	.07 -	.07 -
Red, dry, sck., lb	.06¾-	.07¾-	.08¾-
Lead acetate, white crys., bbl., lb.	.11 - .12	.11 - .12	.11½- .12
Lead arsenate, powd., bbl., lb	.10 - .14	.10 - .14	.13 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb	.05¾-	.06 -	.07½-
Lithophone, bags, lb	.04½- .05	.04½- .05	.04½- .05

	Current Price	Last Month	Last Year
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal	.33 -	.33 -	.38 -
97%, tanks, gal	.34 -	.34 -	.39 -
Synthetic, tanks, gal	.35½-	.35½-	.40½-
Nickel salt, double, bbl., lb	.10½- .11	.10½- .11	.10½- .11
Single, bbl., lb	.10½- .11	.10½- .11	.10½- .11
Orange mineral, csk., lb	.09¾-	.09½-	.10¾-
Phosphorus, red, cases, lb	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb	.31 - .32	.31 - .32	.31 - .32
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05 - .05½	.05 - .05½	.05½- .06
Chlorate, powd., lb	.08 - .08½	.08 - .08½	.08 - .08½
Cyanide, cs, lb	.55 - .57	.55 - .57	.55 - .57
First sorts, csk., lb	.08¾- .09	.08¾- .09	.08¾- .09
Hydroxide (c'stic potash) dr., lb.	.06¼- .06¾	.06¼- .06¾	.06¼- .06¾
Muriate, 80% bgs., ton	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb	.04½- .05	.04½- .05	.047- .05
Salsoda, bbl., cwt	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	16.00 -18.00	16.00 -18.00	15.00 -18.00
Soda ash, light, 58%, bags, contract, cwt	1.15 -	1.15 -	1.32 -
Dense, bags, cwt	1.17½-	1.17½-	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb	.05 - .06	.05 - .06	.04½- .05
Bicarbonate, bbl., cwt	1.85 - 2.00	1.85 - 2.00	2.00 - 2.25
Bichromate, casks, lb	.05 - .06	.06 - .07	.07 - .07½
Bisulphate, bulk, ton	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb	.05½- .07½	.05½- .07½	.05½- .07½
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb	.15½- .16	.16½- .17	.17 - .18
Fluoride, bbl., lb	.07½- .08	.07½- .08	.08 - .09
Hyposulphite, bbl., lb	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt	1.77 -	1.77 -	2.03 -
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb	.0265 - .03	.0265 - .03	.02¾- .03
Prussiate, yel. drums, lb	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, crys., bbl., lb	.03 - .03½	.03 - .03½	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb	.05 - .06	.05 - .06	.05 - .06
Dioxide, cyl., lb	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb	nom.-	nom.-	nom.-
Oxide, bbl., lb	.24½-	.25 -	.29 -
Crystals, bbl., lb	.23½-	.22½-	.25½-
Zinc chloride, gran., bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb	.41 - .42	.41 - .42	.41 - .42
Dust, bbl., lb	.05½- .06	.05½- .06	.07½- .08
Zinc oxide, lead free, bag, lb	.06¾-	.06¾-	.06¾-
5% lead sulphate, bags, lb	.06¾-	.06¾-	.06¾-
Sulphate, bbl., cwt	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb	$0.09½-$0.10½	$0.09½-$0.10	$0.11½-$0.12½
Chinawood oil, bbl., lb	.07½-	.07 -	.07½-
Coconut oil, Ceylon, tanks, N. Y. lb	.03½-	.03½-	.05½-
Corn oil crude, tanks, (f.o.b. mill), lb	.03½-	.03½-	.07¼-
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.03½-	.03½-	.06½-
Linseed oil, raw, car lots, bbl., lb.	.067-	.072-	.088-
Palm, Lagos, casks, lb	.04½-	.04 -	.06½-
Niger, casks, lb	.03½-	.03½-	.05½-
Palm Kernel, bbl., lb	.05½-	.05½-	.06½-
Peanut oil, crude, tanks (mill), lb.	.03½-	.04 -	.07 -
Rapeseed oil, refined, bbl., gal	.39 - .41	.42 - .43	.54 - .56
Soya bean, tank (f.o.b. Coast), lb	nom.-	nom.-	.08 -
Sulphur (olive foots), bbl., lb	.04½-	.04½-	.06½-
Cod, Newfoundland, bbl., gal	.25 - .27	.30 - .32	.45 - .50
Menhaden, light pressed, bbl., gal.	.33 - .34	.33 - .34	.40 - .42
Crude, tanks (f.o.b. factory), gal.	.20 -	.17½-	.20 -
Whale, crude, tanks, gal	nom.-	nom.-	- .78
Grease, yellow, loose, lb	.02¾-	.02¾-	.04½-
Oleo stearine, lb	.05½-	.06¾-	.08½-
Red oil, distilled, d.p. bbl., lb	.07½-	.07½-	.08¼-
Tallow, extra, loose, lb	.02¾-	.03¼-	.04½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb	.24 - .25	.24 - .25	.24 - .52

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb....	$1.10 -$1.25	$1.10 -$1.25	$1.15 -$1.25
Benzidine base, bbl., lb.........	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb.....	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb....	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal..	.20 - .21	.20 - .21	.21 - .22
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb..........	.12½- .14	.12½- .14	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.54 - .58	.54 - .58	.58 - .61
Diethylaniline, dr., lb...........	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb...........	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb...........	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal.............	.23 - .25	.26 - .28	.26 - .28
Diphenylamine, bbl., lb..........	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb.................	.65 - .70	.65 - .70	.68 - .70
Naphthalene, flake, bbl., lb.....	.03¾- .04¼	.03¾- .04¼	.03¾- .04¼
Nitrobenzene, dr., lb............	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb........	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb.......	.29 - .30	.29 - .31	.29 - .31
Phenol, U.S.P., drums, lb.......	.14¼- .15	.14¼- .15	.14¾- .15
Picric acid, bbl., lb.............	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb................	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb.................	.40 - .44	.40 - .44	.40 - .44
Resorcinal, tech., kegs, lb.......	.70 - .80	.70 - .80	1.15 - 1.25
Salicylic acid, tech., bbl., lb.....	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.25 - .30
Tolidine, bbl., lb...............	.86 - .88	.86 - .88	.88 - .90
Toluene, tanks, works, gal.......	.30 -......	.30 -......	.30 -......
Xylene, com., tanks, gal........	.26 -......	.26 -......	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton...	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb...........	.07½- .14	.07½- .14	.09½- .12
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb...	.03 - .20	.03 - .20	.03½- .20
Prussian blue, bbl., lb........	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb.......	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb........	.27 - .28	.27 - .28	.27 - .30
Carmine red, tins, lb..........	5.00 - 5.40	5.00 - 5.40	6.00 - 6.50
Para toner, lb................	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb.....	1.55 - 1.60	1.55 - 1.60	1.75 - 1.90
Chrome yellow, C. P., bbl., lb.	.16½- .17	.16½- .17	.16½- .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb......	.06 - .08	.06 - .08	.07 - .09
Manila, bags, lb............	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb.....	.16 - .16½	.16 - .19	.16 - .16½
Kauri No. 1 cases, lb.........	.45 - .48	.45 - .48	.48 - .53
Kieselguhr (f.o.b. N.Y.), ton...	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton............	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb....	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb..........	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl.................	3.95 -......	4.00 -......	5.35 -......
Turpentine, gal................	.39½-......	.39 -......	.43½-......
Shellac, orange, fine, bags, lb....	.37 - .38	.38 - .40	.41 - .42
Bleached, bonedry, bags, lb...	.28 - .30	.28 - .30	.28 - .30
T. N. bags, lb..............	.13 - .14	.16 - .17	.17 - .18
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton..	8.00 - 8.50	8.00 - 8.50	9.50 -......
300 mesh (f.o.b. Ga.), ton....	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton..	13.75 -......	13.75 -......	13.75 -......

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb..........	$0.16 -$0.20	$0.16 -$0.20	$0.21 -$0.23
Beeswax, ref., light, lb..........	.25 - .27	.25 - .27	.29 - .30
Candelilla, bags, lb............	.14½-......	.14½- ...	.15 - .16
Carnuba, No. 1, bags, lb.........	.27 - .28	.32 - .33	.24 - .25
Paraffine, crude			
105-110 m.p., lb..............	.03½- .03¾	.03½- .04½	.04 - .04½

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton.......	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton.....	80.00-85.00	80.00-85.00	94.00-99.00
Ferrochrome, 65-70%............	.11-.....	.11-.....	.......-.....
Spiegeleisen, 19-21% ton.........	30.00-.....	30.00-.....	33.00-.....
Ferrosilicon, 14-17%, ton.........	31.00-.....	31.00-.....	39.00-.....
Ferrotungsten, 70-80%, lb.......	1.00- 1.10	1.00- 1.10	1.10-.....
Ferrovanadium, 30-40%, lb......	3.15- 3.50	3.15- 3.50	3.15- 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb..........	$0.07½-......	$0.07 -......	$0.10 -......
Aluminum, 96-99%, lb...........	.233-......	.233-......	.233-......
Antimony, Chin. and Jap., lb.....	.06½-......	.06½-......	.073-......
Nickel, 99%, lb................	.35 -......	.35 -......	.35 -......
Monel metal blocks, lb..........	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb........	.20½-......	.20¾-......	.25¾-......
Lead, New York, spot. lb.........	.0375-......	.0385-......	.04¾-......
Zinc, New York, spot, lb.........	.0345-......	.035-......	.0435-......
Silver, commercial, oz...........	.30 -......	.29¾-......	.30½-......
Cadmium, lb...................	.55 -......	.55 -......	.70 -......
Bismuth, ton lots, lb............	1.50 -......	1.50 -......	1.00 -......
Cobalt, lb.....................	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb......	.30 -......	.30 -......	.48 - 1.00
Platinum, ref., oz...............	40.00 -......	40.00 -......	36.00-......
Palladium, ref., oz..............	19.00 - 21.00	19.00 - 21.00	21.00- 22.00
Mercury, flask, 75 lb............	65.00 - 66.00	67.00 - 68.00	105.00-107.00
Tungsten powder, lb............	1.45 -......	1.45 -......	1.65-......

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton.......	$6.50 -$8.25	$6.50 -$8.25	$6.50 -$8.25
Chrome ore, c. f., post, ton.......	17.00 -20.00	17.00 -20.00	19.50 -24.00
Coke, fdry., f.o b. ovens, t	2.75 - 2.85	2.75 - 3.85	2.75 - 2.85
Fluorspar, gravel, f.o.b. Il., ton...	17.25 -20.00	17.25 -20.00	17.25 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit...........	.25 - .26	.24 - .25	.25 - .26
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb............	.45 -......	.45 -......	.33 - .35
Monazite, 6% of ThO_2, ton..,.....	60.00 -......	60.00 -......	60.00 -.. ...
Pyrites, Span. fines, c.i.f., unit....	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb..........	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit..............	10.50 -12.00	10.50 -12.00	10.50 -12.00

Current Industrial Developments

New Construction and Machinery Requirements

Acid Mixing Plant—Bureau of Yards & Docks, Navy Department, Washington, D. C., received low bids for construction of acid mixing plant, battery overhaul building and sub-station at Navy Yard, Mare Island, Calif.

Chemical Plant—Dooner & Smith Chemical Co., 374 Mulberry St., Newark, N. J., awarded contract for addition and alterations to factory at 264 New Jersey Railroad Ave. to Frank J Berger, 230 Belmont Ave., Newark. Estimated cost $40,000.

Plant—Crossett Chemical Co., C. J. Warner, Crossett, Ark., considering construction of a mill to use charcoal fuel in manufacture of dannemora iron or steel, etc. Estimated cost $25,000.

Enamelware Plant — Dominion Enamelware Co. Ltd., Toronto, Ont., considering erection of a new plant at Toronto.

Flashlight Plant—Collins Flashlight Corp., C. B. Collins, Pres., Martinsville, Va., has work under way on construction of first unit of plant for the manufacture of patented no-battery flashlights. Work being done by owner's forces under the supervision of H. H. Dudley.

Gas Plant—Central Hudson Gas & Electric Corp., South Road, Poughkeepsie, N. Y., plans construction of a gas plant and distribution system at Highlands.

Gas Plant — Empire Gas & Electric Co., Geneva, c/o New York Central Electric Corp., 50 Church St., New York, made application to Public Service Commission for permit to construct gas plant and distribution system at Spafford.

Gas Plant—New York Central Electric Corp., 50 Church St., New York, N. Y., has been granted permit by Public Service Commission for construction of a gas plant and distribution system at Woodhull.

Gas Plants—New York State Electric & Gas Corp., Central Ave., Ithaca, N. Y., made application to Public Service Commission for permit to construct gas plant and distribution system at Freeville, also electric distribution system and plant at Coventry.

Gas Plants—New York State Electric & Gas Corp., Central Ave., Ithaca, N. Y., has been authorized by Public Service Commission to construct gas plant at Dansville, also plans plant and distribution system at Van Elten.

Gas Manufacturing Plant—Commercial Gases Co. Inc., c/o North Jersey Industrial Terminal Co., 1827 Bergen Turnpike, North Bergen, N. J., awarded contract for construction of a 2 story acetylene gas manufacturing plant on 39th St. to Bonanno Bros., 1827 Bergen Turnpike, North Bergen. Estimated cost $40,000.

Gasoline Plant—Gulf Refining Co., Comal St., San Antonio, Tex., plans construction of a casing-head gasoline plant at Overton. Estimated cost $75,000. Private plans.

Glass Factory—United Socialist Soviet Russia, c/o Amtorg Trading Corp., 261 5th Ave., New York, N. Y., plans construction of a window glass factory, 2,700,000 sq. meters annual capacity at Ashkhabad.

Glass Furnace—Allegheny Glass Corp., R. A. Hill, Pres., Mount Jewett, Pa., plans construction of glass tank including glass furnace, refractory materials supported by structural steel.

Helium Building—Bureau of Yards & Docks, Navy Department, Washington, D. C., receiving bids for a group of buildings including helium building, medium pressure helium storage building, boiler plant, etc., at Naval air station, Sunnyvale, Calif.

Laboratory—Bureau of Yards & Docks, Navy Department, Washington, D. C., awarded contract for construction of a new building at Naval Research laboratory, Bellevue, to Blackford Co., Greensboro, N. C. $101,443.

Laboratory—Department of Education, State Education Bldg., Albany, N. Y., will soon award contract for construction of a laboratory at College of Forestry, Syracuse University, Syracuse.

Laboratory — Hospital Department, Boston, Mass., plans construction of surgical research laboratory unit at Boston City Hospital, Harrison Ave. Architect not selected. $500,000 bequeathed by C. H. Tyler of Beverly for this purpose.

Laboratory—John B. Pierce Foundation, c/o H. G. Ullman, 235 Oakland Ave., Yonkers, N. Y., having preliminary plans prepared for a 2 story, 45 x 55 ft. laboratory at Liberty St. and Congress Ave., New Haven, Conn. H. Longsing Quick, 18 Getty Sq., Yonkers, N. Y., is architect.

Laboratory—School Committee, Weston, Conn., awarded contract for construction of a 1 story, 120 x 150 ft. school building including laboratory, etc., to T. J. Pardy Co., 1481 Seaview Ave., Bridgeport.

Laboratories—Board of Regents, University of Texas, c/o J. W. Calhoun, Comptroller, Austin, Tex., will receive bids until January 29 for construction of a group of buildings including engineering, geology and physics laboratories, etc., on University campus. Estimated total cost $3,225,000.

Laboratories (Chemistry and Geology)—California Institute of Technology, Pasadena, Calif., having revised plans prepared for construction of chemistry and geology laboratory buildings at 1201 East California St. Estimated cost $300,000.

Pharmaceutical Supplies Factory—A. S. Boyle Co., Windsor, Ont., manufacturers of pharmaceutical supplies, preparing plans for construction of a 3 story, 60 x 140 ft. factory for the manufacture of pharmaceutical supplies at Campbell Ave. and College St. Pennington & Boyde, Security Bldg., Windsor, are architects.

Science Building—Department of Institutions & Agencies, State Office Bldg., Trenton, and Rutgers University, College Ave., New Brunswick, N. J., will receive bids until January 18 (extended date) for construction of a 3 story, 70 x 145 ft. agricultural science building at State Experimental Farm, New Brunswick. Estimated cost $150,000. Alex Merchand, 1 Elm Row, New Brunswick, is architect. Saul Shaw & Co., 24 Commerce St., Newark, are engineers.

Leather Factory—Lampert Leather Co., Hancock St., Peabody, Mass., plans reconstruction of factory recently destroyed by fire. Estimated cost $90,000. Architect not selected.

Liquid Chlorine and Sulphuric Acid—Passaic Valley Water Commission, 156 Ellison St., Paterson, N. J., will receive bids until January 19 for liquid chlorine for Little Falls filter plant, also 50 to 75 ton per month of 60° sulphuric acid made from brimstone for 1932.

Marble Factory—Plastic Art Marble Co., 321 11th St., Carlstadt, N. J., will soon award contract for a 2 story factory on 14th St. Estimated cost $40,000. J. Thomas Camlet, 26 Piaget Ave., Clifton, is architect.

INDUSTRIAL BUILDING CONTRACTS
in 1930 and 1931 ($40,000 or more)

	1931		1930	
	No.	Value Thousands	No.	Value Thousands
Aircraft	1	$75	5	$2,230
Automotive	4	3,120	22	6,380
Garages	160	9,994	225	18,090
Chemicals, fine	5	895	9	855
Chemicals, heavy	19	1,038	40	13,527
Clay products	8	630	14	1,254
Coke	1	40	4	1,179
Cold storage warehouses	21	4,099	16	9,727
Other warehouses	105	22,940	141	31,361
Electric power plants	125	38,648	194	86,137
Electrical supplies	9	4,435	....	....
Explosives	...	....	2	215
Fertilizer	3	190	3	205
Foundries	15	1,686	29	2,146
Glass	4	4,740	7	650
Iron and steel and their products	12	3,435	69	34,083
Leather	9	500	12	695
Cement	...	....	3	165
Lumber and woodworking	14	686	17	1,400
Machine shops	35	2,263	81	6,153
Manufactured gas	12	1,192	11	4,110
Oils, vegetable and animal	2	115	2	370
Paint and varnish	4	280	8	750
Paper and pulp	11	1,290	13	4,777
Petroleum products	36	5,286	52	15,600
Printing and binding	32	6,217	37	6,938
Pyroxylin products	...	....	5	2,240
Radio	...	....	3	221
Rayon	1	1,000	1	75
Other textiles	32	2,067	24	3,300
Rubber products	6	440	13	1,269
Soap	1	75	5	2,450
Sugar	1	40	....	....
Other food products	161	13,583	233	21,289
Process industries not previously mentioned	19	3,388	14	2,355
Miscellaneous factories	115	20,360	345	48,975
Total	992	$155,163	1,659	$331,171

*Eleven months.

Mining Development — American Smelting & Refining Co., 120 Broadway, New York, N. Y., plans gold mining development and exploration at Kernville, Calif., including buliding, machinery and equipment. Estimated cost to exceed $100,000. Purchases on large scale dependent upon results of exploration.

Mineral Mining—C. A. Godfrey, Gail, Tex., plans under way for installing proper equipment for preparation of ammonium chloride on 6,400 acres under lease. Private plans. Address owner reference to equipment.

Paint Manufacturing Plant—John Lucas & Co., 521 Washington St., New York, N. Y., plans reconstruction of plant destroyed by fire or re-equipment of building to be acquired. Estimated cost to exceed $40,000.

Paint Manufacturing Plant — United Copper Mining & Paint Co. Ltd., c/o Frederick Beutal, Pres., 936 East 60th St., Los Angeles, Calif., plans erection of a copper paint plant at Phoenix, Ariz. Estimated cost $50,000.

Potash Plant—Texas Potash Co., Republic Bank Bldg., Dallas, Tex., having surveys and testhole explorations made for construction of a potash refining plant and mine unit in vicinity of Odessa. Estimated cost $2,000,000.

Printing Ink Factory—General Printing Ink Corp., 100 6th Ave., New York, N. Y., will establish a branch factory for the manufacture of its products at 179 John St., Toronto, Ont. Perry D. Richards, c/o owner in charge of purchases of equipment to be installed in existing building which new plant will occupy.

Refinery—General Manganese Corp., 155 West Congress St., Detroit, Mich., plans construction of first unit of refinery plant, ultimately ten units at Sioux Falls, S. D. Initial cost $270,000.

Refinery — Charles Jeffreys, 38 Liberty St., Newark, N. J., awarded contract for construction of a 2 story refinery to Levine Bros., 519 South 14th St., Newark. Estimated cost $40,000.

Refinery—Owner, c/o Alfred Peter, 207 Market St., Newark, Newark, N. J., Archt., will soon award contract for construction of a 2 story refinery. Estimated cost $40,000.

Refinery (Oil) — Federated Oil & Refineries Ltd., St. John, N. B., plans construction of initial plant. Estimated cost $100,000.

Refinery (Oil)—State Department of Finance, Santiago, Chile, plans government owned refinery or granting of concession with government interest.

Refinery (Oil and Gas)—Rio Oil & Gas Co., Rio Grande, Tex., will build an oil and gas refinery, 350 bbl. daily capacity by day labor. Estimated cost $75,000. Considering purchase of machinery and equipment.

Rubber Factory—Epple & Kahrs, 17 Washington St., Newark, N. J., archts., will soon award contract for addition and alterations to factory on Oliver St., for Owner, c/o Architects.

Soda Products Plant—Iowa Soda Products Co., Council Bluffs, Ia., plans reconstruction of plant destroyed by fire. Estimated cost $150,000.

INDUSTRIAL NOTES

SHARPLES SPECIALTY Co., Philadelphia, Pa., has appointed C. J. Lamb as New York District Manager.

MATERIALS HANDLING INSTITUTE was formed by 70 representatives of manufacturers of materials handling equipment at Cleveland for the purpose of educating industries in available mechanical handling facilities.

LUKENS STEEL COMPANY, Coatesville, Pa. has appointed the Dravo-Doyle Company as representative at 300 Penn Ave., Pittsburgh.

AUTOMATIC TRANSPORTATION Co., INC., has appointed C. B. Crockett and R. L. Smith as eastern general sales agents with main offices in New York and further offices at Boston, Hartford, Buffalo, Newark, Philadelphia, Pittsburgh, Washington, Baltimore and Charlotte, N. C.

METER-EKSTROM Co., Chicago, has moved its offices to 565 West Washington Blvd.

HARRY P. NICHOLS, has resigned from the American Abrasive Metals Co., to become a consulting engineer at 7 Dey St., New York.

HOMESTEAD VALVE MFG. Co., Coraopolis, Pa., has appointed the General Supply & Equipment Company, 1419 Maryland Ave., Baltimore, Md., as representatives.

VICTOR CHEMICAL WORKS has removed its general offices to Board of Trade Building, 141 West Jackson Blvd., Chicago.

CUNO ENGINEERING CORP., Meriden, Conn. has appointed the Sheffler-Gross Co., Inc., representatives at 203 Drexel Bldg., Philadelphia, Pa.

MINER L. HARTMANN, consulting chemical engineer and patent attorney, has moved his offices to 635 Chamber of Commerce Bldg., Los Angeles, Calif.

GENERAL REFRACTORIES Co., Philadelphia, Pa., has appointed F. L. McManus, vice-president in charge of traffic, E. M. Thorpe, vice-president in charge of sales, and L. Tschirky, vice-president and assistant to president.

LUKENWELD, INC., Coatesville, Pa., has appointed Henry H. Peck as manager of sales.

BABCOCK & WILCOX Co. has consolidated the sales offices of its subsidiary, the Fuller Lehigh Co., with its own throughout the country.

PATTERSON ENGINEERING CORP., Akron, Ohio, has been organized by R. L. Cawood, P. E. Wolton, and R. B. Cuntz as a subsidiary of the Patterson Foundry & Machine Co., East Liverpool, Ohio.